Reading Material for

Dental Technician

Paper-A

Compiled By:

Punjab Medical Faculty

Specialized Healthcare & Medical Education Department

Government of the Punjab

PREFACE

A two years post matric teaching program of Dental Technician for the students of Allied Health Sciences. The purpose of this reading material is to provide basic education to the paramedics about oral anatomy, tooth morphology, prosthodontics, science of dental materials and sterilization. This reading material attempts to cover almost all the basic theoretical knowledge required by students in these subjects so that they can perform their work better in Dental Laboratories.

Subjects

- Oral Anatomy
- Tooth Morphology
- Science of Dental Materials
- Prosthodontics (part 1)
- Sterilization

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ORAL ANATOMY

CHAPTER NO 1
INTRODUCTION

DEFINITION

The branch of science which deals with study of structure and form of living things is known as **anatomy**.

Terminologies

Fossa:	Depression
Pit:	Pinpoint depression
Fissure:	Cleft
Groove:	Linear depression
Process:	Outgrowth and projection
Ridge:	Linear elevation
Medial:	Towards the midline
Lateral:	Away from midline
Proximal:	Towards the origin
Distal:	Away from origin
Anterior:	Nearer the front
Posterior:	Nearer the back end

ORAL ANATOMY

Study of structure of oral (mouth)tissues is called oral anatomy.

Oral cavity contains many tissues including teeth, gingiva (gums), bones and their covering tissues, muscles, tongue, salivary glands and blood and nerve supply of all these tissues.

IMPORTANCE OF ORAL ANATOMY

Knowledge of oral anatomy will help dental technicians:

i. In formation of complete dentures and partial dentures
ii. In designing crowns
iii. In taking impression and pouring cast
iv. In fabrication of removable or fixed dental appliances

CHAPTER NO 2
OSTEOLOGY

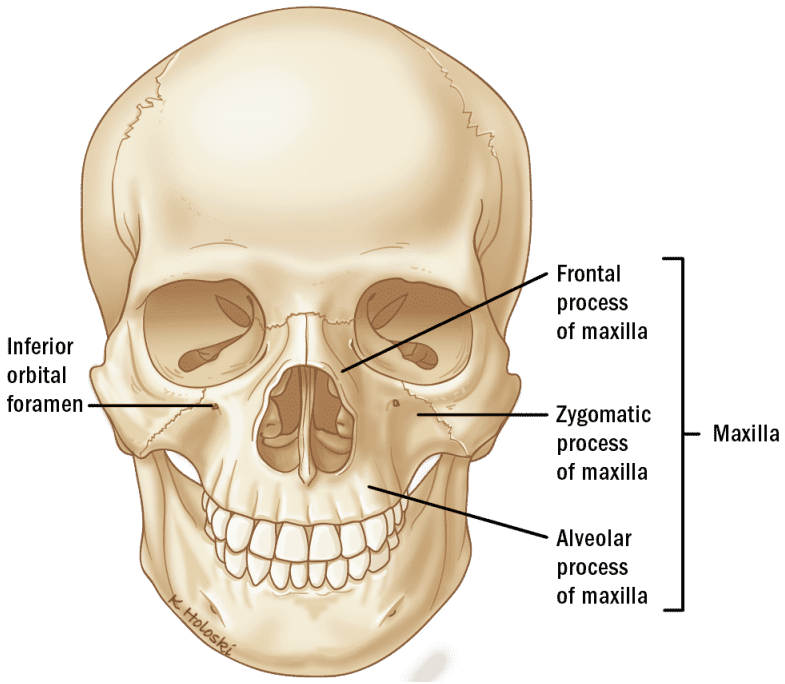
Osteology is the study of bones and joints. There are three important bones / joint to study for dental technician.

- Maxilla
- Mandible
- TMJ

MAXILLA

Maxilla is second largest bone of face. It is important part of facial skeleton. It has two parts:

- Body of maxilla
- 4 processes of maxilla (Frontal, Zygomatic , Alveolar , palatine)



Parts of Maxilla

LANDMARKS OF MAXILLARY CAST

- Labial frenum
- Labial vestibule
- Buccal frenum
- Buccal vestibule
- Rugae area
- Median palatine raphe
- Maxillary tuberosity
- Hamular notch
- Residual alveolar ridge
- Posterior palatal seal area

Important Landmarks on Maxillary Cast

MANDIBLE

- Largest bone of face
- It forms lower jaw
- It has two parts:
    - Body and pair of rami

Body of Mandible

It has following features:

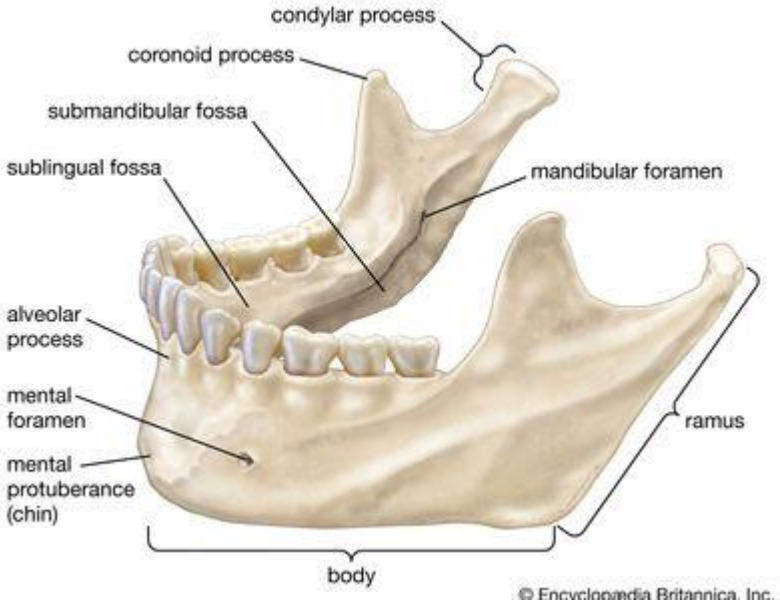
- Symphasis menti

- Mental protuberance
- Mental foramen
- Oblique line
- Incisive fossa
- Mylohyoid line
- submandibular fossa
- Sublingual fossa

Ramus

Ramus has following features:

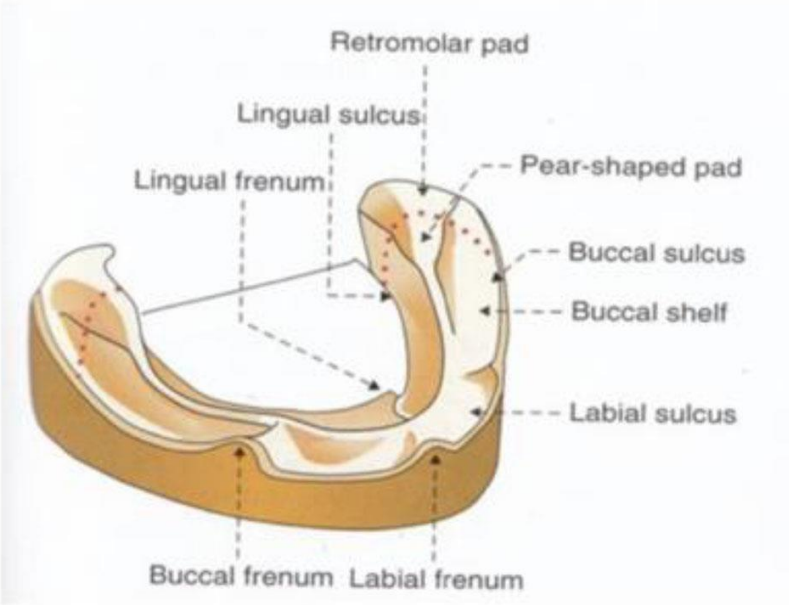
- Quadrilateral in shape
- 2 surfaces (lateral and medial)
- 4 borders (upper, lower, anterior, posterior)
- 2 processes (coronoid and condyloid)



Mandible

LANDMARKS OF MANDIBLULAR CAST

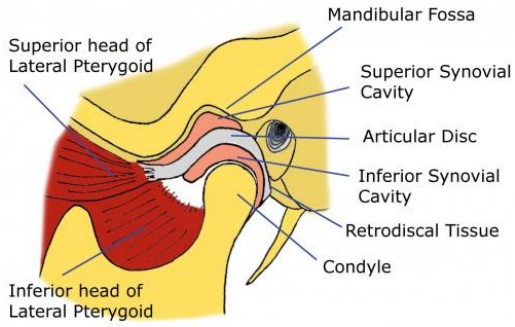
- Labial frenum
- Labial vestibule
- Buccal frenum
- Buccal vestibule
- Lingual frenum
- Alveololingual sulcus
- Residual alveolar ridge
- Buccal shelf
- Retromolar pad
- Buccal sulcus
- Mylohyoid ridge



Anatomical Landmarks of Mandibular Cast

TEMPOROMANDIBULAR JOINT

- TMJ has a special importance in dentistry. It has following salient features: It is a synovial joint.
- Upper articular surface formed by articular tubercle and mandibular fossa.
- Inferior articular surface formed by head of condyle.
- Articular surfaces are covered with fibrocartilage.
- It has 3 ligaments (sphenomandibular ligament, stylomandibular ligament, and lateral ligament) and).
- Joint cavity is divided into upper and lower compartment by intra articular disc.
- Superficial temporal and maxillary artery give blood supply to the TMJ.
- Auricular temporal and masseteric nerves give nerve supply to joint.



The Temporomandibular Joint

CHAPTER NO 3
NERVES

DEFINITION

Nerve is defined as group of fibers which transfer impulses from brain and spinal cord to body and from body to brain and spinal cord.

CRANIAL NERVES

- Set of 12 paired nerves that arise directly from the brain.
- Following cranial nerves are important in dentistry:
    - Trigeminal nerve
    - Facial nerve
    - Glossopharyngeal nerve

TRIGEMINAL NERVE

- 5^{th} cranial nerve
- Origin from mid pons of the brain.

  Pathway:

It originates from 3 sensory nuclei and 1 motor nucles.

- At the level of pons sensory nuclei merge.
- In middle cranial fossa it forms trigeminal ganglion.
- Peripheral aspect gives 3 branches:

    - Ophthalmic
    - Maxillary
    - Mandibular

Maxillary Nerve

It has following branches:

- Meningeal branch to middle cranial fossa
- Ganglionic branches
- Zygomatic branches
- Alveolar branches
- Infraorbital branches

Mandibular Nerve

It has following branches:

- Meningeal
- Nerve to medial pterygoid muscle
- Deep temporal
- Nerve to lateral pterygoid muscle
- Masseteric
- Buccal
- Auriculotemporal
- Lingual
- Inferior alveolar

FACIAL NERVE

- 7^{th} cranial nerve
- Originates from four nuclei in lower pons.
- Pathway: It is attached to brain stem by two roots. These roots run forward with 8^{th} cranial nerve to reach internal acoustic meatus. It leaves skull through stylomastoid foramen.

Branches

It has following branches:

- Greater petrosal nerve
- Nerve to stapedius
- Chorda tympani
- Posteriors auricular
- Digastric
- Stylohyoid
- Temporal
- Zygomatic
- Buccal
- Marginal mandibular
- Cervical

GLOSSOPHARYNGEAL NERVE

- It is 9^{th} carinal nerve
- Origin: From upper part of medulla

- Pathway: Fibers of nerves pass from medulla to jugular foramen. It leaves the skull from jugular foramen.

Branches

It has following branches:

- Tympanic
- Carotid
- Pharyngeal
- Muscular
- Tonsillar
- Lingual

Chapter no 4

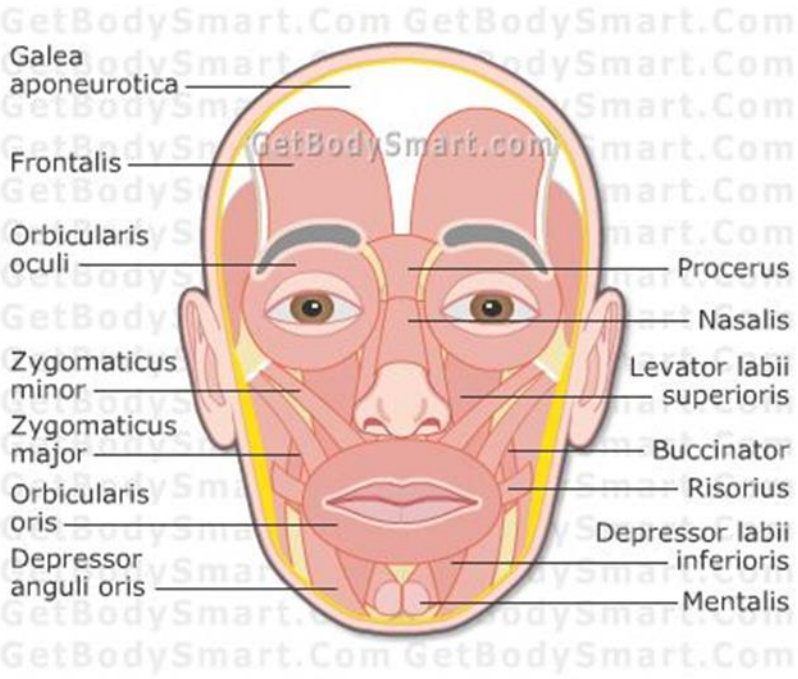
MUSCLES

MUSCLES OF MASTICATION

- Masseter
- Temporal
- Lateral pterygoid
- Medial pterygoid

Muscle	Origin	Insertion	Description
Masseter	Zygomatic arch	Mandible (external surface)	Closes jaw; flat, thick muscle
Temporalis	Temporal bone	Coronoid process at the anterior border of the ramus	Closes jaw; fan-shaped
Medial pterygoid	Sphenoid, palatine, and maxillary bones	Inner (medial) surface of the ramus	Closes jaw; parallels masseter muscle
Lateral pterygoid	Sphenoid bone	Anterior surface of mandibular condyle	Opens jaw; a' grinding act side, and pro mandible

MUSCLES OF FACIAL EXPRESSION



CHAPTER NO 5

ANATOMY (HISTOLOGY) OF TOOTH

Tooth has two parts:
Crown and Root.

Crown is the part of tooth that is seen in the oral cavity.

Root is the part of tooth that is inside the bone.

Tooth has following tissues:

- Enamel
- Dentine
- Pulp
- Cementum

ENAMEL

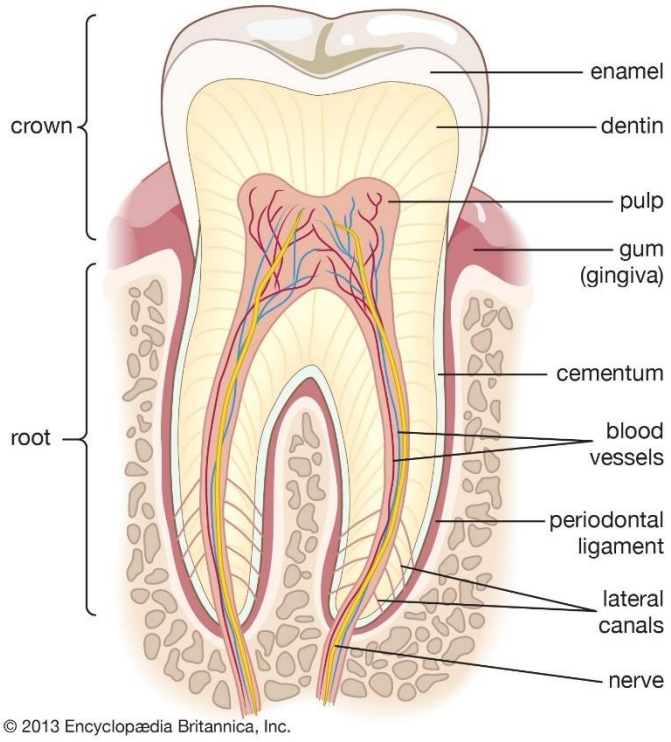
- Enamel is the outermost layer of tooth.
- It is strongest and hardest tissue of body.
- It is made up of rod, rod sheath and inter prismatic substance.
- It develops from enamel organ.
- Ameloblasts deposit tooth enamel during tooth development.
- Its maximum thickness is 2 to 2.5 mm.
- Its color varies from greyish white to yellow white.
- Inorganic content : 96%
- Organic content : 4%
- Shape of enamel rod is like key hole.
- Formation of enamel is known as amelogenesis

DENTIN

- Dentin is second layer of tooth and makes the body of tooth.
- It is made up of 70% inorganic substance, 20% organic material and 10% water.
- It is yellowish in color.

- It is mineralized, avascular tissue.
- It contains dentinal tubules that run from surface of pulp to outer part of dentin.
- Dentinal tubules contain dentinal fluid.
- Types of dentin are:

    - ❖ Primary dentin
    - ❖ Secondary dentin
    - ❖ Tertiary dentin



PULP

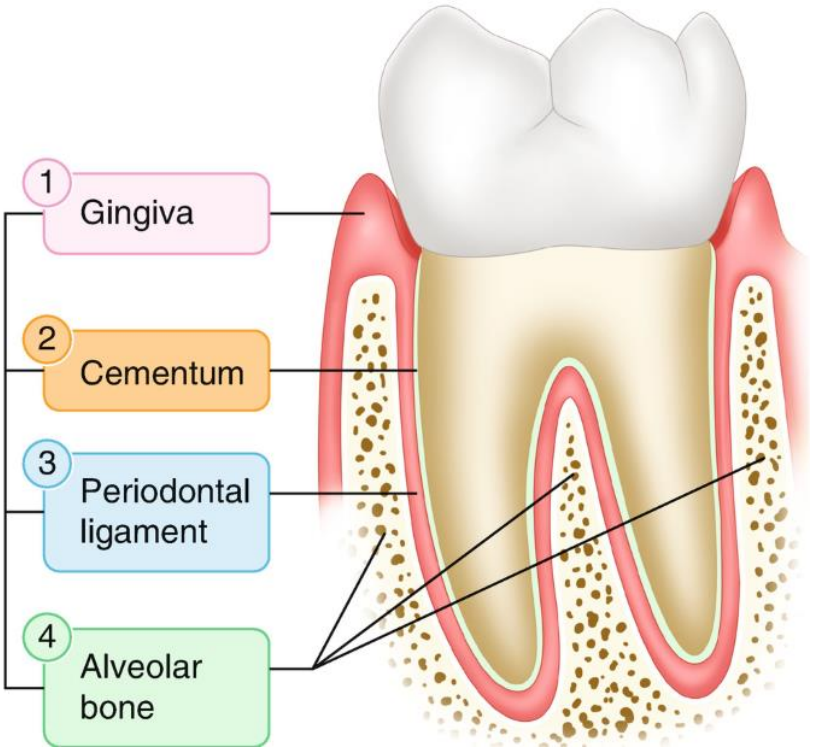
- Pulp is the innermost part of tooth.
- It is composed of soft connective tissue, nerves and blood vessels.

- Pulp is present in a cavity, the pulp cavity. In crown portion of tooth, pulp cavity is called pulp chamber and in root portion of tooth it is called root canal.
- Pulp chamber becomes smaller with age.

- Pulp canal extends from cervical region of crown to root apex.

PERIODONTIUM

- Periodontium includes those anatomical structures which provide strength and anchorage of teeth in jaws.
- These four tissues are:
  - ❖ Gingiva
  - ❖ Periodontal ligament (PDL)
  - ❖ Cementum
  - ❖ Alveolar bone



Periodontium

CHAPTER NO 6

ANATOMY OF TONGUE

Tongue is a muscular organ which is present on the floor of mouth. It is used for taste speech, mastication and swallowing.

GROSS ANATOMY

Tongue is made of voluntary skeletal muscles. Muscles are:

- Palatoglossus
- Hyoglossus
- Styloglossus
- Genioglossus

Tongue is supplied by lingual artery. Root of tongue is supplied by tonsillar artery. Nerve supply of tongue is by hypoglossal nerve. Only palatoglossus muscle is supplied by accessory nerve. Chorda tympani is nerve of taste for anterior two thirds of tongue. Glossopharyngeal is nerve of taste for posterior one third of tongue.

HISTOLOGY

- Tongue is made of striated muscle.
- Mucus membrane is made of stratified squamous epithelium and layer of connective tissue.
- On inferior surface it is thin and smooth.
- Both mucous and serous glands lie in the mucous membrane.
- On dorsum of tongue, it has papillae which are foliate fungi and circumvallate.

CHAPTER NO 7

OCCLUSION

DEFINITION

Occlusion is defined as the relationship between the upper and lower teeth at rest and in function.

TYPES OF OCCLUSIONS

Static Occlusion: Static occlusion refers to contact between teeth when the jaw is closed and stationary.

Dynamic Occlusion: Dynamic occlusion refers to occlusal contacts made when the jaw is moving.

Classification of Occlusion based on mandibular position:

- Centric occlusion
- Eccentric occlusion

Centric Occlusion: It is the ideal or habitual relation of upper and lower teeth when the jaw is closed in in maximum intercuspation.

Eccentric occlusion: Relationship between upper and lower teeth when the jaw is in position other than centric occlusion.

Functional Occlusion: Relationship between upper and lower teeth when the jaw is in lateral or protrusive position during functional activities.

Lateral eccentric occlusion: Relationship between upper and lower teeth during lateral (side to side) movements of the jaw.

Protrusive eccentric occlusion: Relationship between upper and lower teeth during protrusive (when jaw is moved forward) movement.

Canine guidance: The canines play a key role in guiding the movement of the jaw during lateral excursions (side-to-side movements) and protrusive movements (forward movements). When the jaw moves laterally or protrudes, the canines make initial contact, guiding the rest of the teeth into contact.

The canines guide the posterior teeth (premolars and molars) apart during lateral and protrusive movements, preventing them from making contact. This design is thought to protect the posterior teeth from excessive lateral forces during functional activities.

Group Function: In a group functional occlusion, multiple teeth, usually from the same functional group (like a group of posterior teeth on one side), share the load and make simultaneous contact during lateral excursions.

Angle's Classification

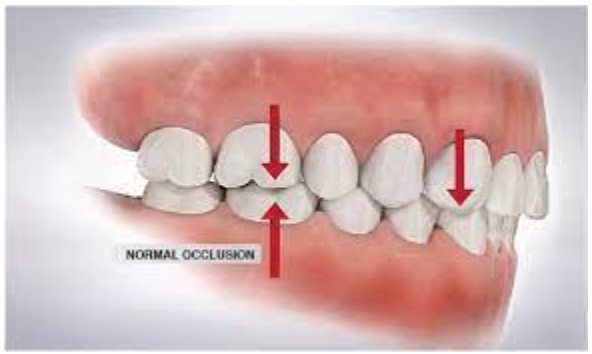
Class I (Orthognathic) occlusion: Normal occlusion

Class II (Retrognathic) occlusion

Class III (Prognathic) occlusion

In normal occlusal relationship mesiobuccal cusp of maxillary 1st molar fits snugly into the mesiobuccal groove of the mandibular 1st molar.

Class II and class III are types of malocclusion.



Types of Cusps

Centric Cusps: The buccal cusps of mandibular posterior teeth and lingual cusps of maxillary posterior teeth are the centric or supporting cusps. These play a major role in chewing.

Non-centric Cusps: The buccal cusps of maxillary posterior teeth and lingual cusps of mandibular posterior teeth are guiding cusps. These are responsible for shearing the food.

MALOCCLUSION

Malocclusion means the teeth are not aligned properly.

TOOTH MORPHOLOGY

CHAPTER NO 1

INTRODUCTION

DEFINITION OF TOOTH MORPHOLOGY

Tooth morphology is defined as the study of structure and anatomical features of tooth (both primary and permanent dentition).

CLINICAL IMPORTANCE

Study of tooth morphology is important for dental technician for fabrications of crowns, veneers and partial dentures.

ANATOMICAL TERMS RELATED TO TOOTH MORPHOLOGY

- Buccal: Towards cheeks
- Labial: Towards lips
- Lingual: Towards tongue
- Incisal: Toward biting edge
- Cusp: Round elevation on occlusal surface of teeth
- Ridge: Linear elevation
- Groove: Linear depression

CHAPTER NO 2

TOOTH NUMBERING SYSTEM

DENTAL FORMULA

This formula represents the number of teeth present in the half of the upper jaw and half of the lower jaw by using letters and figures.

I 2/2 C1/1 P2/2M3/3

IMPORTANCE OF TOOTH NUMBERING SYSTEM

Tooth numbering system is important to understand by technicians to follow instructions given by dentist for formation of crown and dentures.

TYPES OF TOOTH NUMBERING SYSTEM

- Universal numbering system
- Palmer notation system
- FDI system

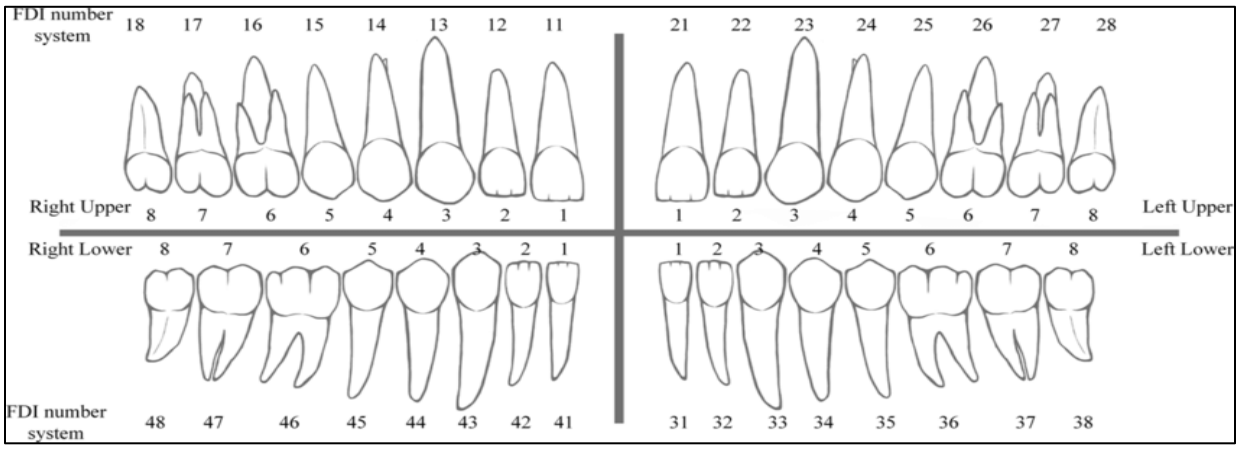


Figure 1: FDI numbering system

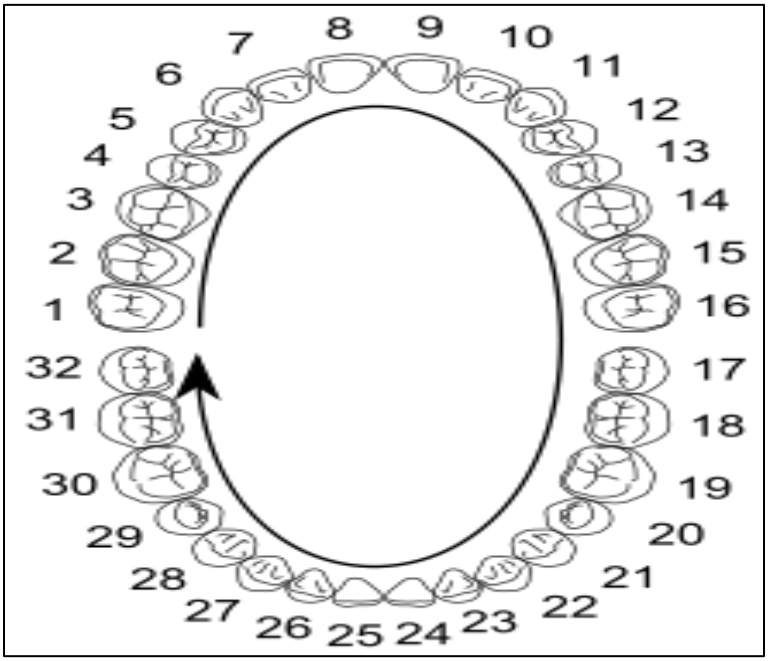


Figure 2: Universal Tooth numbering system

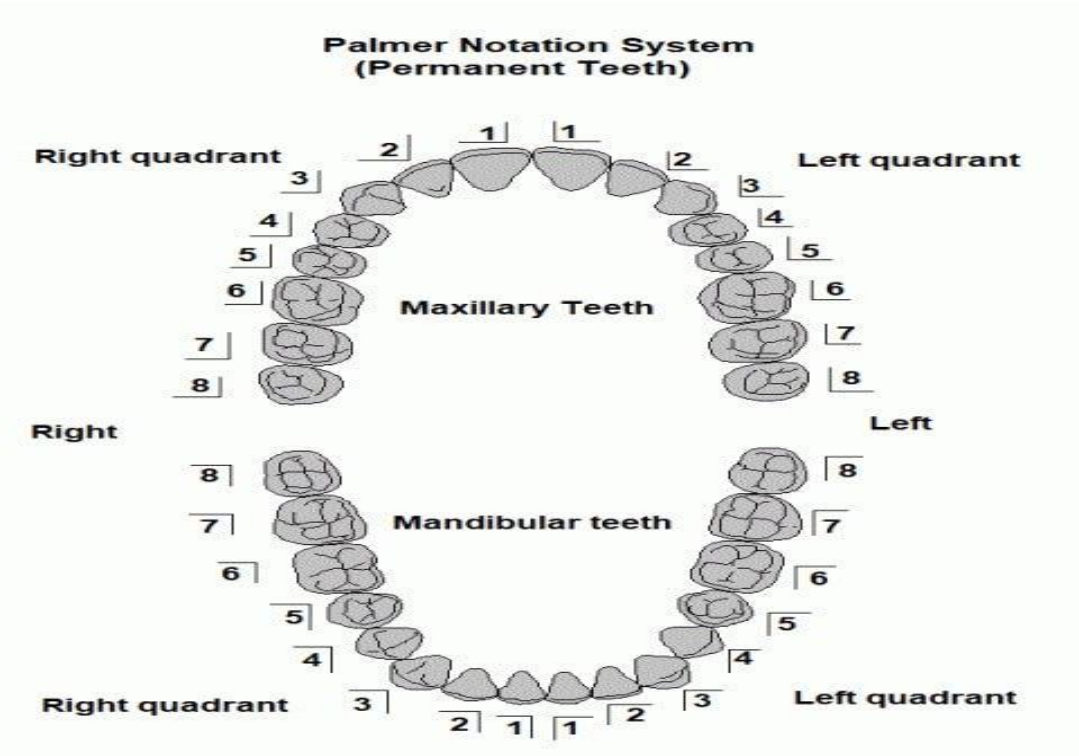


Figure 3: Palmar Tooth numbering system

CHAPTER NO 3
PRIMARY DENTITION

NUMBER OF TEETH IN PRIMARY DENTITION

- It is composed of 20 teeth.
- 10 teeth in each arch.
- 5 teeth in each quadrant.

ERUPTION SEQUENCE

Order of eruption is as follows:

1. Central incisor
2. Lateral incisor
3. 1st molar
4. Canine
5. 2nd molar

PRIMARY INCISOR

- There are two maxillary central incisors in primary dentition.
- There are two mandibular central incisors in primary dentition.
- There are two lateral incisors both in maxillary and mandibular arches in primary dentition.
- They have labial, lingual, mesial, distal and incisal surfaces.

PRIMARY CANINE

- There are two maxillary canines in primary dentition.
- There are two mandibular canines in primary dentition.
- Root of primary canine is long and more than twice the crown length.
- Mandibular canine is 0.5 mm shorter than maxillary canine.

PRIMARY MOLARS

- There are four maxillary molars and four mandibular molars in primary dentition.

- They are named first and second molars in primary dentition. The primary maxillary 1st molar has four cusps.
- Crown of primary maxillary second molar is quite larger than crown of primary maxillary 1st molar. The roots of primary maxillary 2nd molar are longer and heavier than roots of primary maxillary 1st molar. Primary maxillary second molar is smaller than maxillary first molar in buccal aspect.
- There is cusp of carabelli present on maxillary second molar.
- Primary mandibular 1st molar has four cusps.
    - Primary mandibular 2nd molar resembles mandibular 1st permanent molar except that the crown is smaller in all dimensions.

Primary Teeth

CHAPTER 4

PERMANENT DENTITION

There are 32 teeth in permanent dentition.

ERRUPTION SEQUENCE

Maxilla: 61245378

Mandible: 61234578

PERMANENT INCISORS

- They are 8 in number.
- Four in maxillary arch.
- Four in mandibular arch.
- Two Central incisors in each arch.
- Two lateral incisors in each arch.

Maxillary Central Incisor

It has five surfaces.

- Labial: Rectangular in shape
- Lingual: Reverse of labial surface
- Mesial: Triangular in shape
- Distal: Triangular in shape
- Incisal: Cutting edge
- Root: Conical in shape

Mandibular Central Incisor

It has five surfaces.

- Labial: Bilaterally symmetrical
- Lingual: Lingual tapering
- Mesial: Wedge shape
- Distal: Resembles mesial except less curvature of cervical line
- Incisal: Bilaterally symmetrical
- Root: Straight

Maxillary Lateral Incisor

It has five surfaces.

- Labial: Trapezoidal in shape
- Lingual: Narrow on lingual surface
- Mesial: Smaller than central incisor
- Distal: Thicker on distal side
- Incisal: More convex than central incisor
- Root: Cone shaped

Mandibular Lateral Incisor

It has five surfaces.

- Labial: Narrow long
- Lingual: similar to central incisor
- Mesial: Longer than distal surface
- Distal: Smaller than mesial surface
- Incisal: Slightly curved
- Root: Conical

Canine

- 2 in each arch
- Have single cusp
- Upper canines have longest root in oral cavity

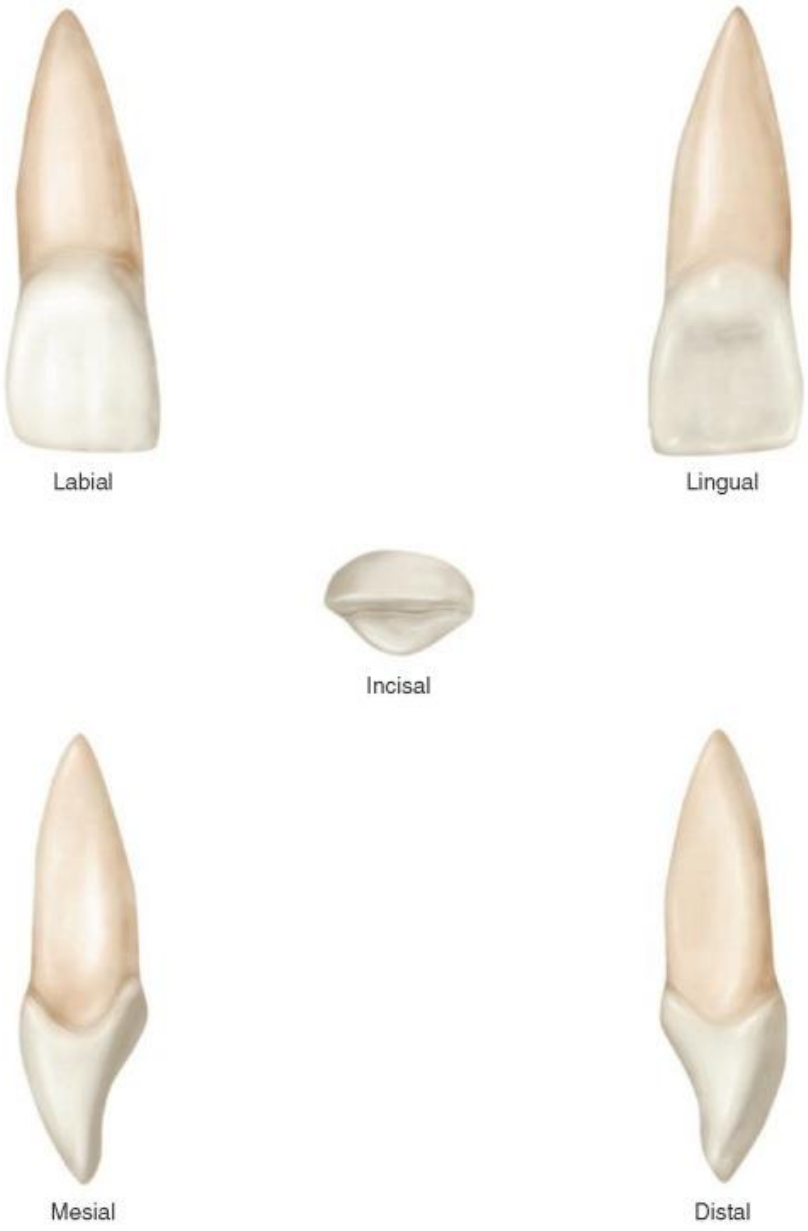
PREMOLAR

- Eight premolars are present in permanent dentition.
- Four premolars in each arch
- Two premolars in each quadrant
- Also known as bicuspid (two cusps)
- They have five surfaces.

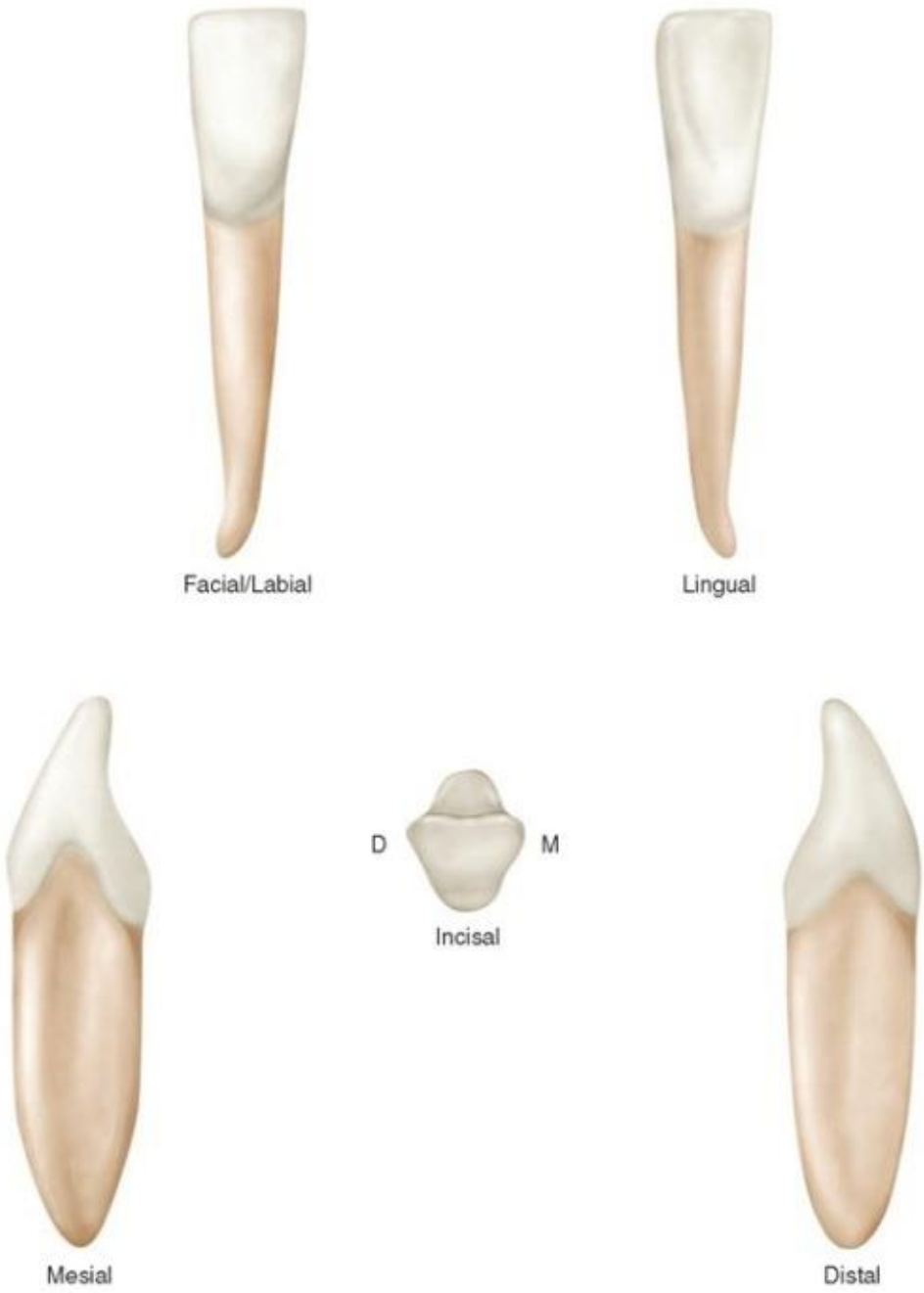
PERMANENT MOLARS

- 12 in numbers
- 6 in each arch
- 3 in each quadrant

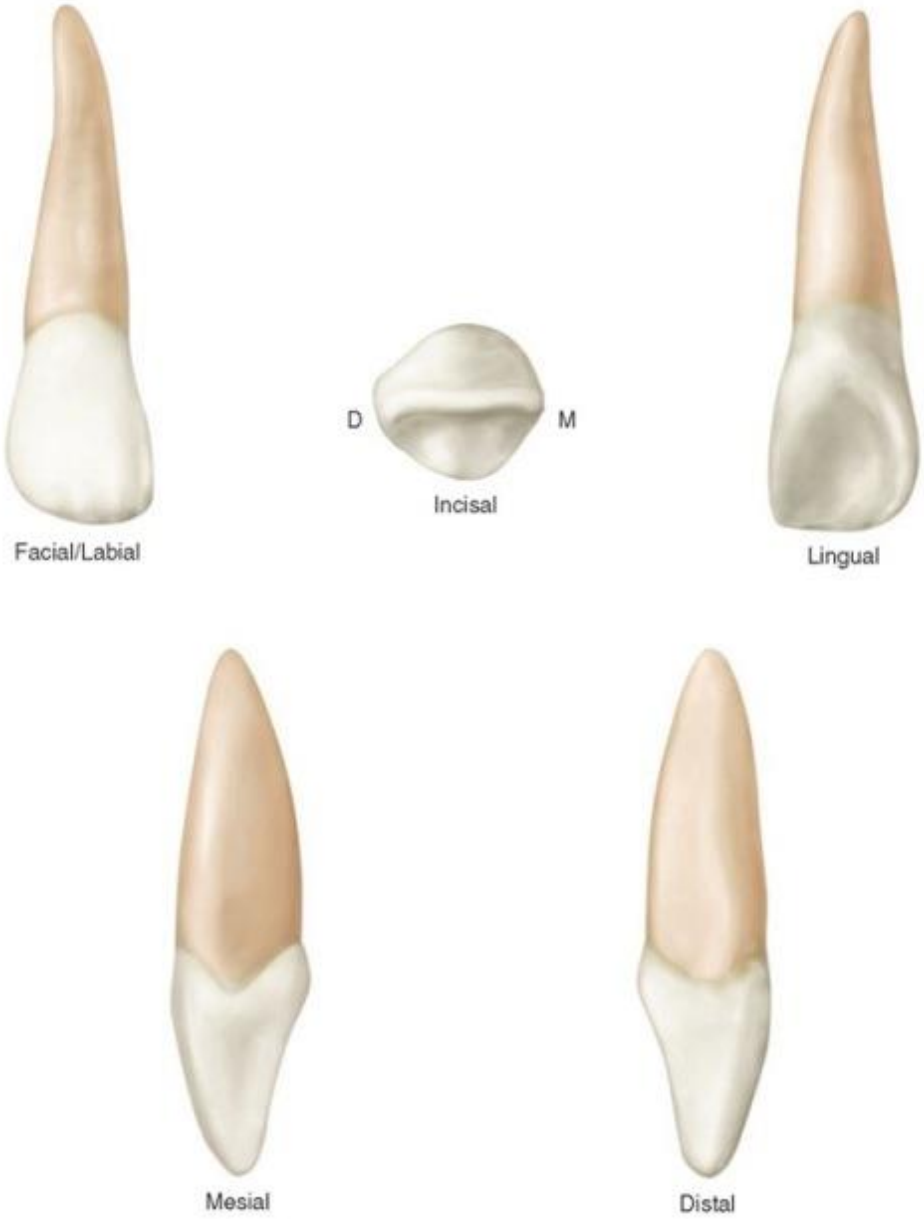
- They have five surfaces:
    - Buccal
    - Lingual
    - Mesial
    - Distal
    - Occlusal



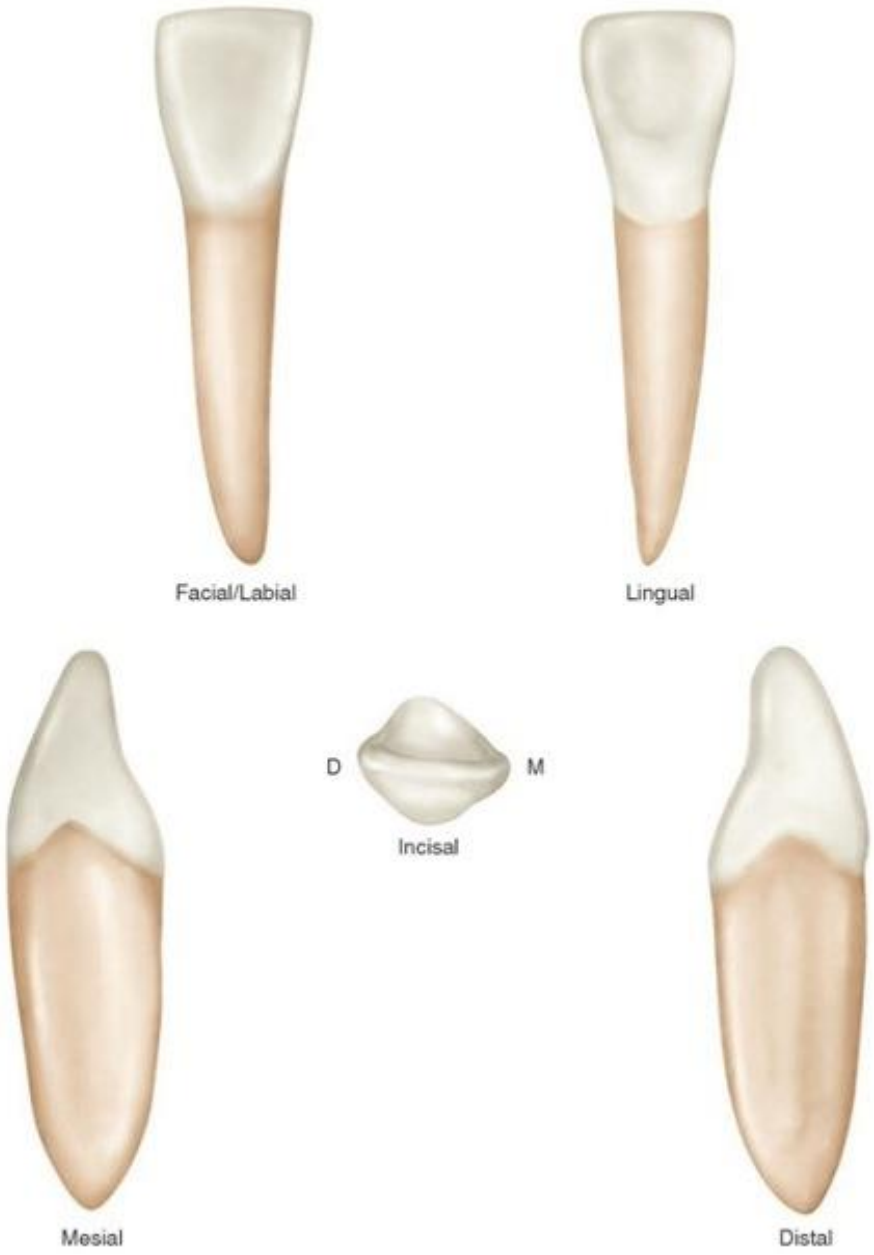
Maxillary Central Incisor



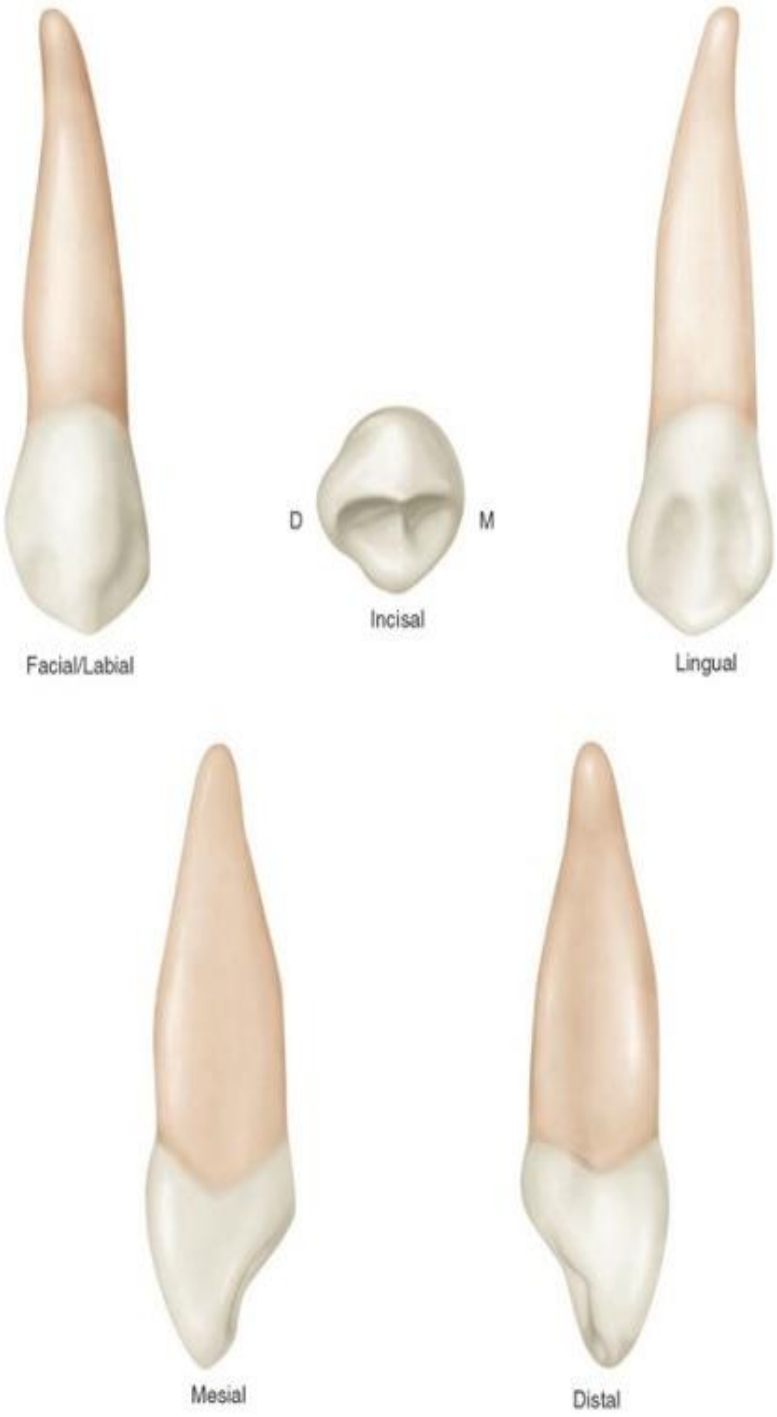
Mandibular Central Incisor



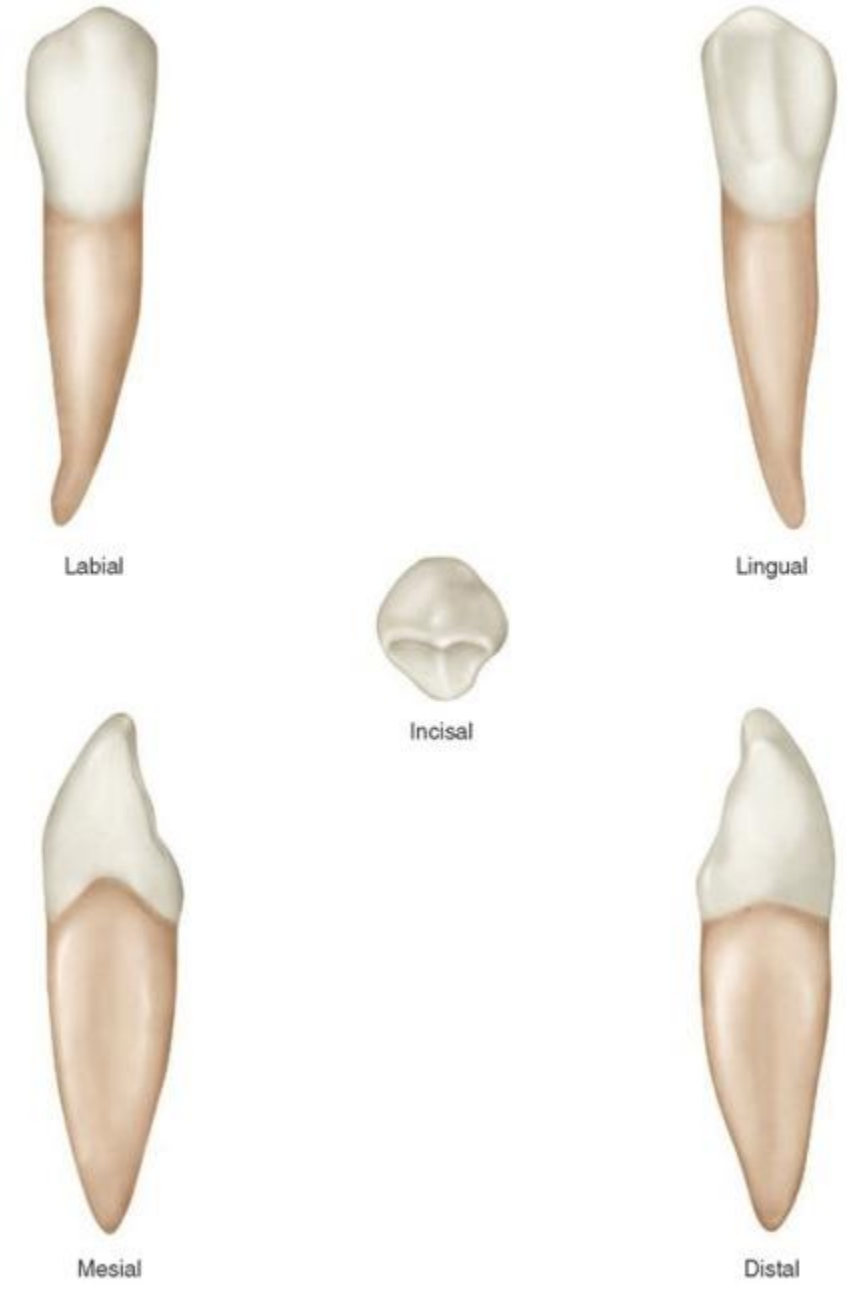
Maxillary Lateral Incisor



Mandibular Lateral Incisor



Maxillary Canine



Mandibular Canine

Buccal

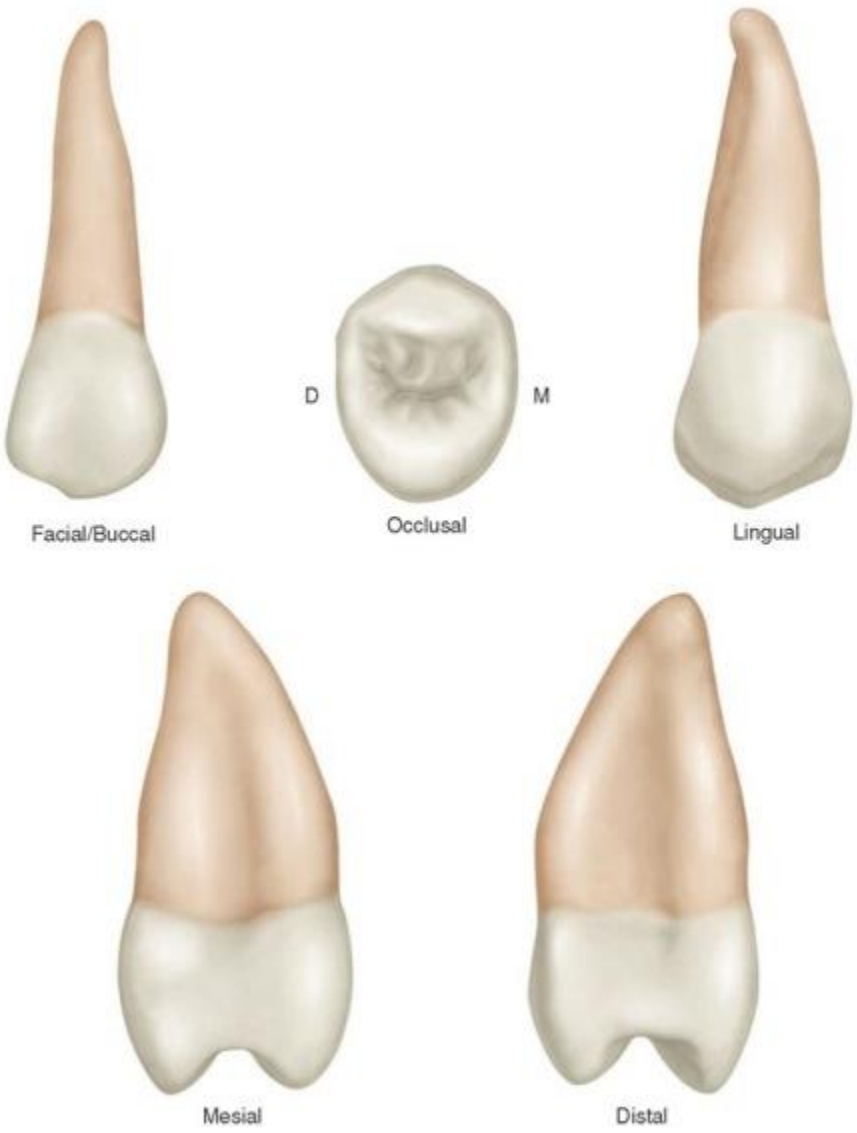
Lingual

Occlusal

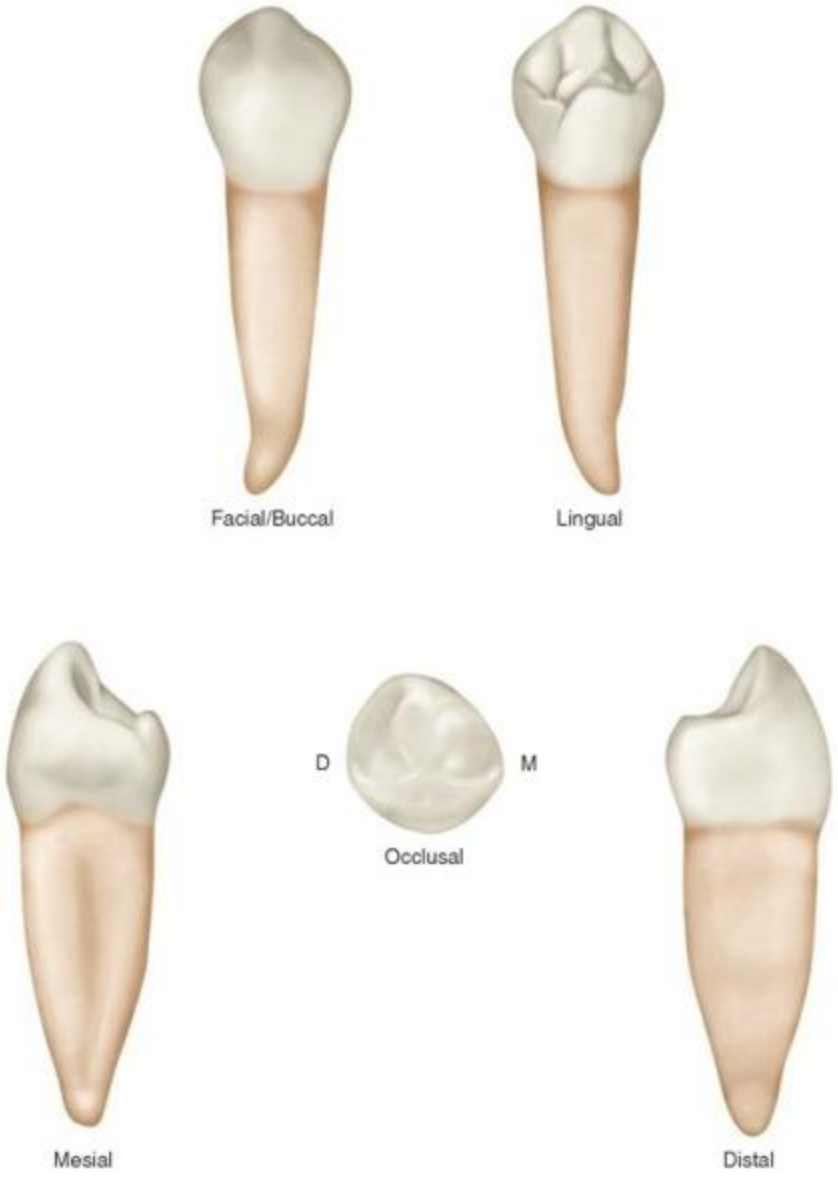
Mesial

Distal

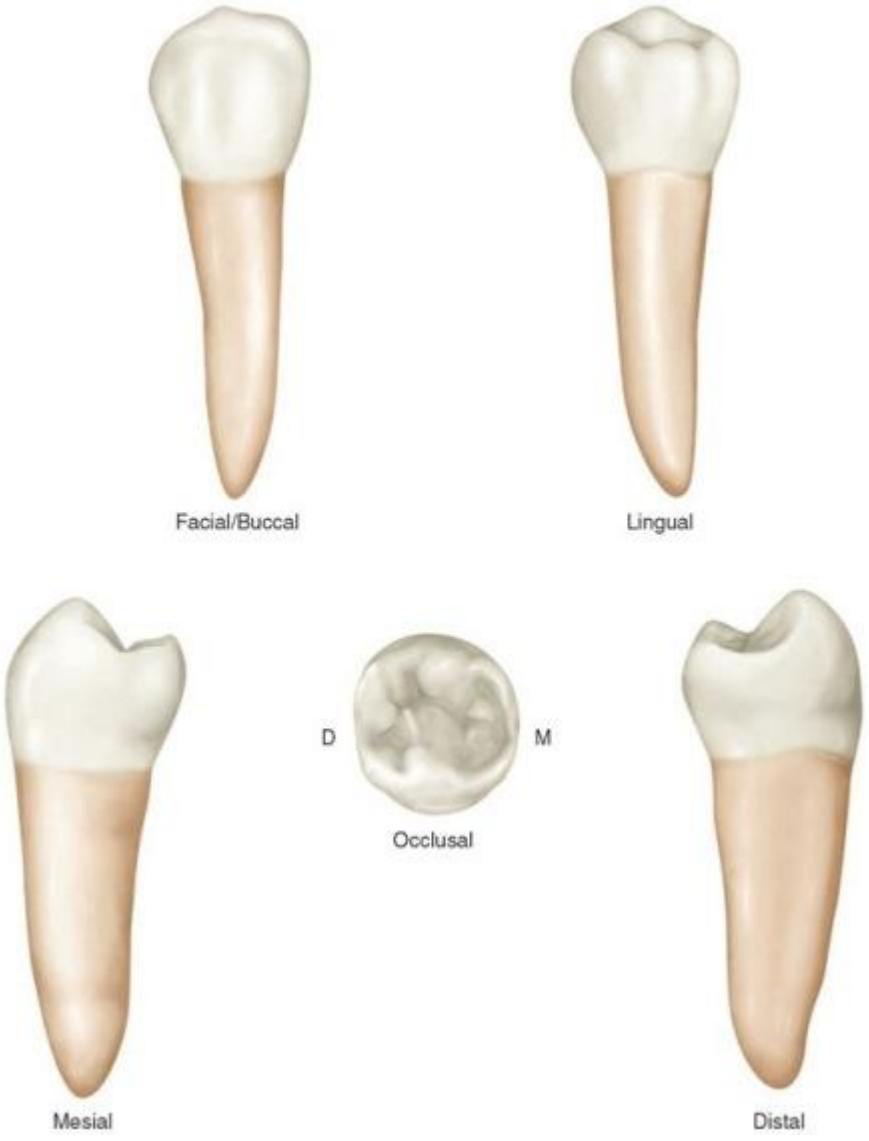
Maxillary First Premolar



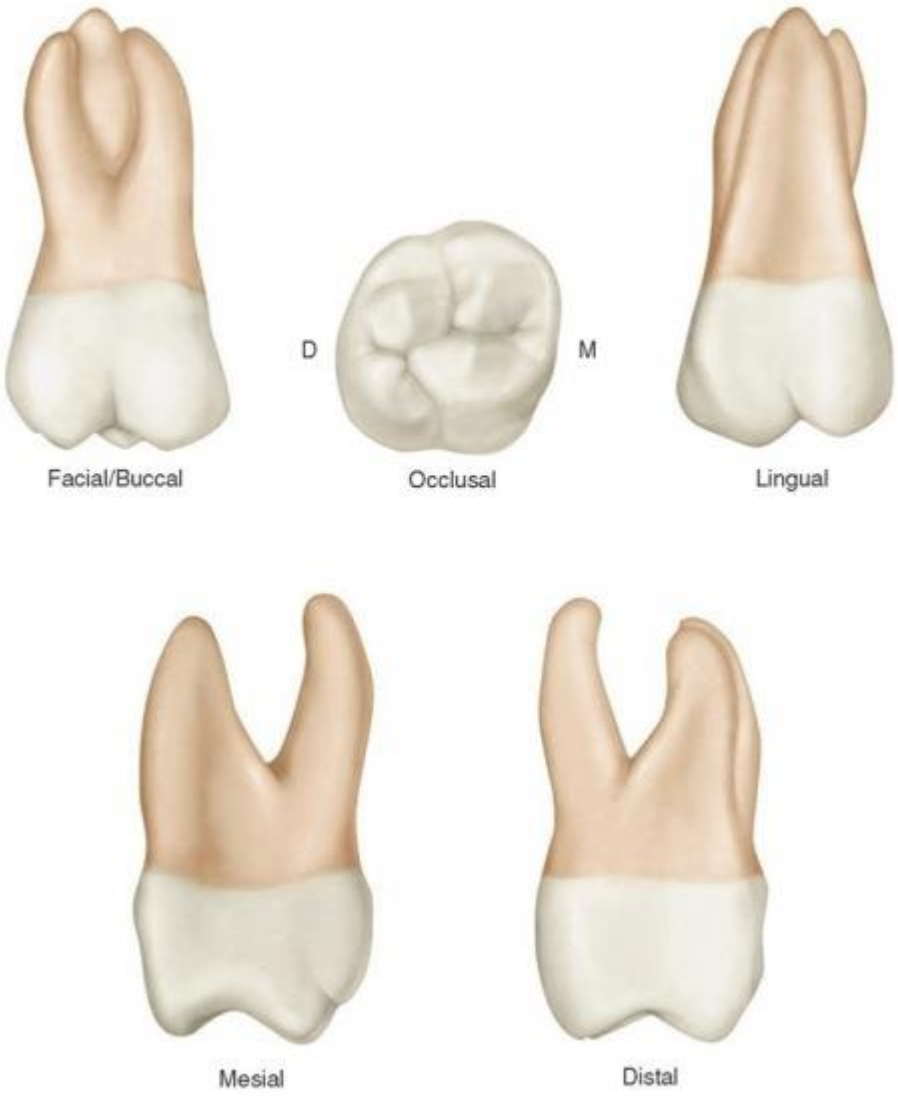
Maxillary Second Premolar



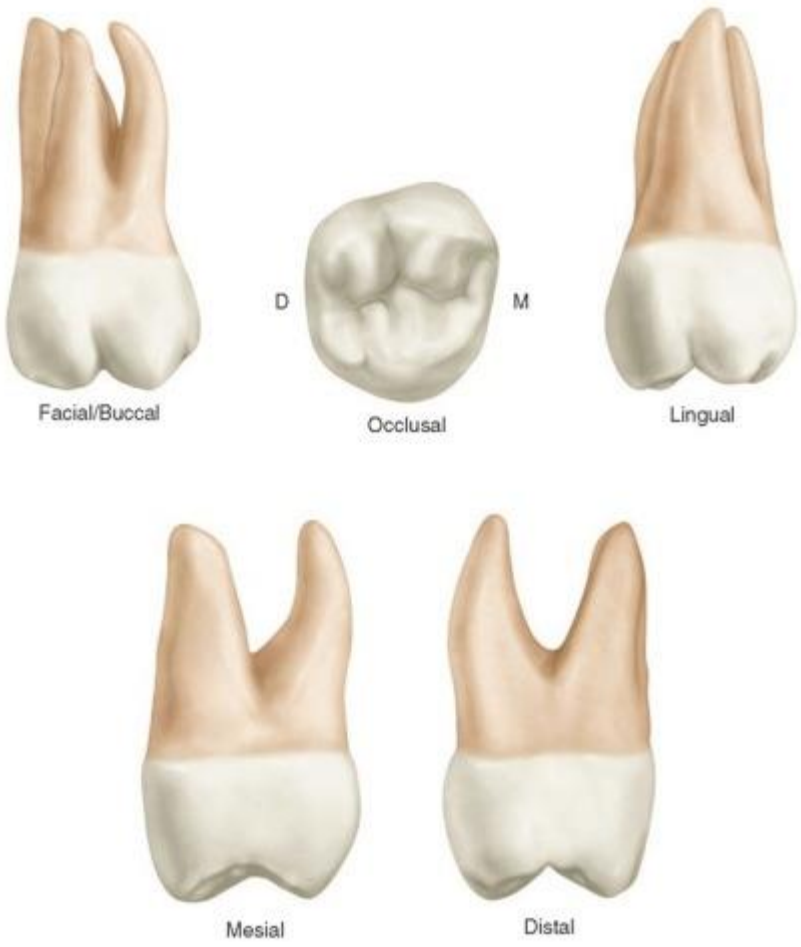
Mandibular First Premolar



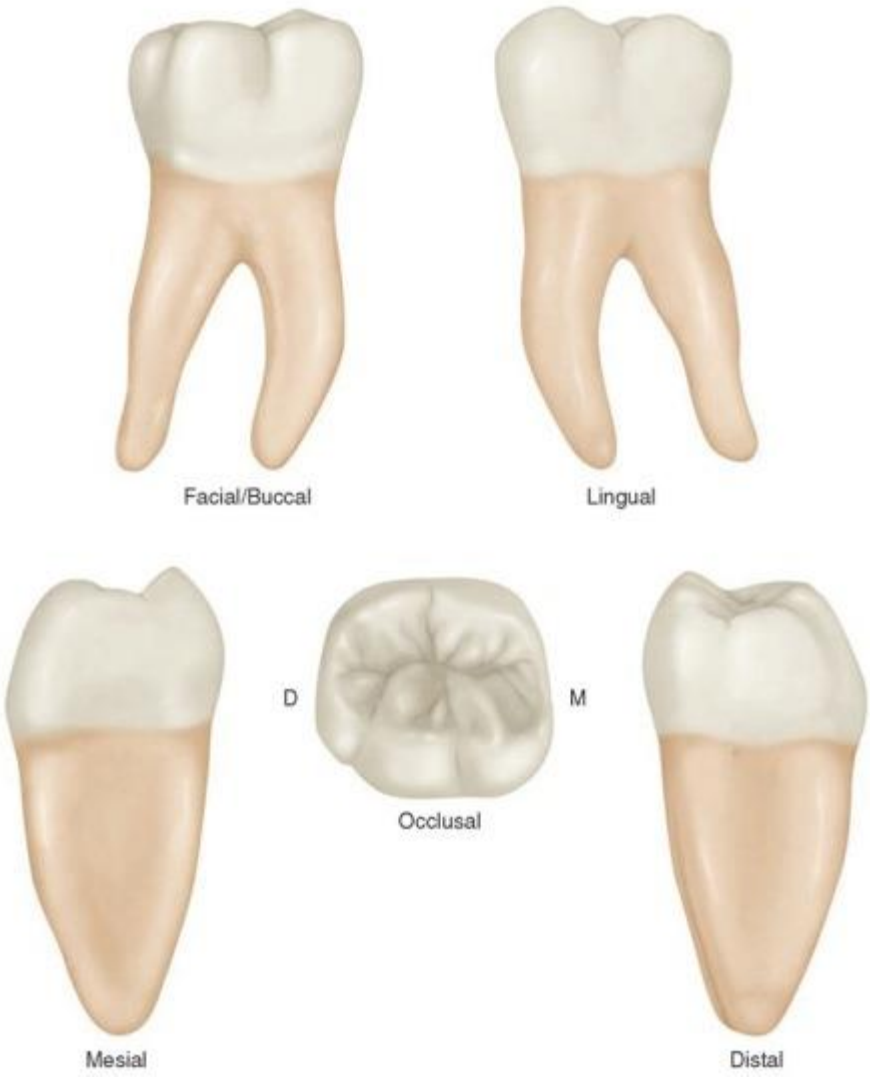
Mandibular Second Premolar



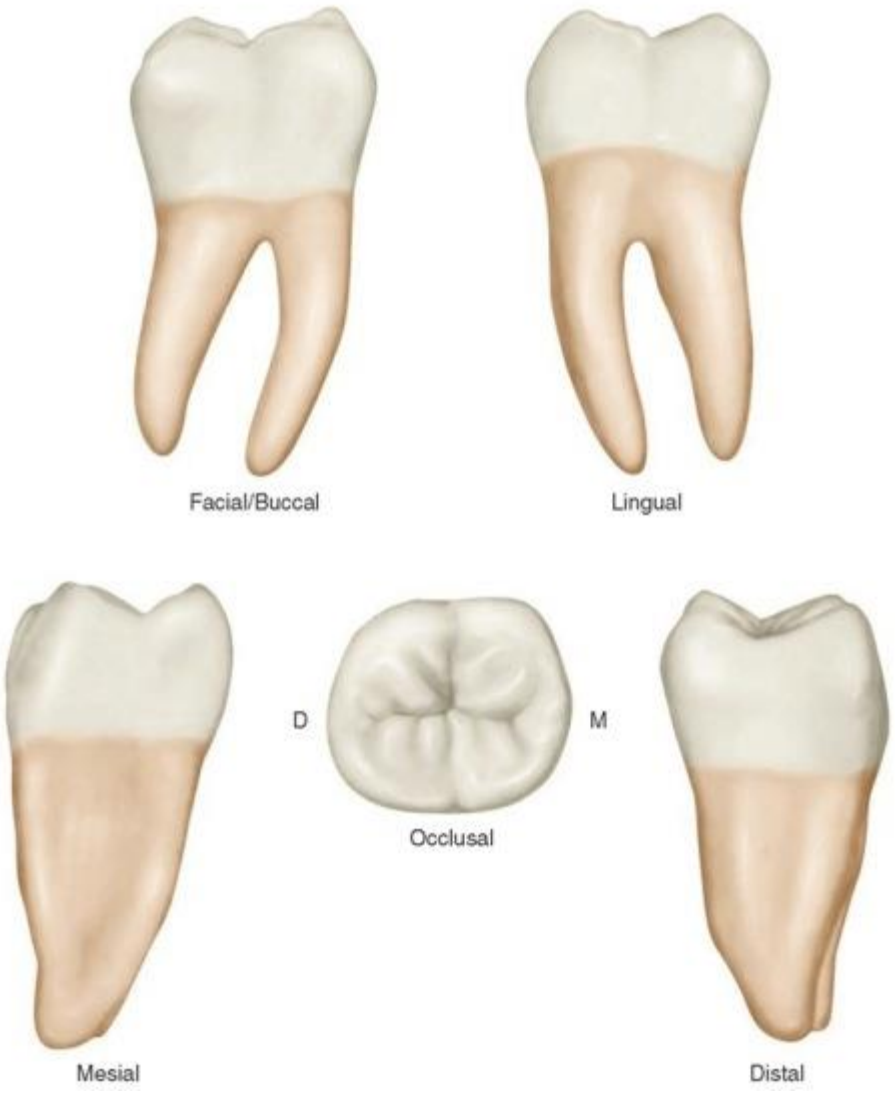
Maxillary First Molar



Maxillary Second Molar



Mandibular First Molar



Mandibular Second Molar

CHAPTER 5
PULP CANAL SYSTEM

DEFINITION
Connective tissue present in center of tooth under dentin is known as pulp.

PULP CHAMBER
It is present in crown of tooth.

PULP CANAL
Section of pulp that extends down the root is known as pulp canal or root canal.

Pulp Canal System

CHAPTER 6
DEVELOPMENT OF TOOTH

DENTAL LAMINA

Band of epithelial tissue seen in developing tooth is known as dental lamina.

It is first sign of tooth development.

It develops in 6th week of intra uterine life.

STAGES OF TOOTH DEVELOPMENT

There are following stages of tooth development:

- Initiation
- Bud stage
- Cap stage
- Bell stage
- Maturation

DENTINOGENSIS

Formation of dentin is known as dentinogenesis.

AMELOGENESIS

Formation of enamel is known as amelogenesis.

CEMENTOGENESIS

Formation of cementum is known as cementogenesis.

CHAPTER 7
DENTAL ANAMOLIES

Abnormalities in size, shape or number of teeth.

Macrodontia	:	Larger than normal teeth in size
Microdontia	:	Smaller than normal teeth in size
Hypodontia	:	Less number of teeth present than normal
Anodontia	:	Absence of all teeth
Supernumerary teeth	:	Extra tooth. Most commonly mesiodens
Dilaceration	:	Sharp bend in root or crown of tooth

PROSTHODONTICS
PART-1

Prosthodontics

The branch of dentistry concerned with the design, manufacture, and fitting of artificial replacements for teeth and other parts of the mouth.

Branches

1. Fixed prosthodontics
2. Removable prosthodontics
  a. Complete Denture
  b. Partial Denture
3. Implant prosthodontics
4. Maxillofacial prosthetics.

Complete Denture

A removable dental prosthesis which replaces the entire dentition and associated structures of maxilla and mandible.

Anatomical Landmarks

1) Limiting Structures:
They determine and confine the extent of denture.

2) Supporting Structures:
These. are the load bearing areas. They show minimum ridge resorption under constant load.

3) Relief Areas:
These areas resorb under constant load. The denture should be designed such that masticatory load is not concentrated over these areas.

Anatomical landmarks in Maxilla

1. Limiting Structures
  Labial frenum
  Labial vestibule
  Buccal frenum
  Buccal vestibule
  Hamular notch
  Posterior palatal seal areas

2. Supporting Structures

a. Primary Stress earing Areas:
   Hard palate
   Posterio-lateral slopes of residual ridge

b. Secondary Stress Bearing Areas:
   Rugae
   Maxillary tuberosity

3. Relief Areas
   Incisive papilla
   Mid-palatine raphe
   Fovea palatine
   Cuspid eminence

Anatomical Landmarks in mandible

1. Limiting Structures:

Labial Frenum
Labial vestibule
Buccal frenum
Buccal vestibule
Lingual frenum
Retromolar pads
Pterygomandibular raphe

2. Supporting Structures

Buccal shelf area
Residual alveolar ridge

3. Relief Areas

Mental foramen
Torus mandibularis
Crest of residual alveolar ridge

Posterior Palatal Seal Area (Potsdam)

The soft tissue at or along the junction of hard and soft palates on which pressure, within physiological limits of tissues, can be applied by a denture to aid in the retention of the denture.

Impression

Negative replica of teeth and surrounding structures of oral cavity

Complete Denture Impression

It is the negative replica of entire denture bearing, stabilizing and border seal areas present in edentulous mouth.

Types of Impression

PRIMARY Impression

Made for purpose of diagnosis for construction of tray.
Materials: Alginate, Impression compound
Trays: Stock trays

SECONDARY Impression

Is taken to prepare a master cast.
Materials: Zinc oxide eugenol impression paste
Trays: Custom/ special tray

Special Tray

It is a custom made device prepared for a particular patient used to carry, confine and control the impression material while making an impression.

Materials used for Special Tray:

a. **Thermoplastic material**
   Shellac base plate
   Impression compound
b. **Resin**
   Self-cure
   Light- cure
   Heat-cure

Conditioning primary cast for making a tray

1. Soak the cast in slurry water.
2. Block undercuts.
3. Borders of tray should be marked by a pencil.
4. Adapting the relief wax in relief areas.
5. Application of separating media.

Composition of Separating Media

1) Cold mould seal is an aqueous solution of sodium alginate (2% in water)
2) Glycerin
3 Alcohol
4) Sodium phosphate
5) Preservatives

Dough Technique

3:1 ratio by volume of Powder to Liquid

1. **Wet Sandy Stage**: Where polymer is soaked in monomer.
2. **Early Stringy Stage**: Where if material is touched, fine filaments are seen sticking to finger.
3. **Late Stringy Stage**: Where long strings are present.
4. **Dough like stage**: In this stage material is workable.
5. **Rubbery Stage**: When material cannot be manipulated anymore.
6. **Stiff Stage**: Material loses its elasticity and becomes more plastic.

Manipulation is done in late stringy and dough stages. The material is kneaded and shaped to 2 mm thick sheet. Separating medium should be applied to avoid stickiness. Rolled sheet of acrylic is adapted over the cast from center to the periphery to prevent formation of wrinkles.

The handle is fabricated using excess dough material. It is parallel to the long axis of the teeth that are to be placed.

Finishing the tray:
Final finishing may be achieved by sandpaper.

Denture Base

Denture base is a part of a denture which rests on tissues and carries artificial teeth. It is also known as base plate or record base. Denture base is used to support the record rim for maxillary mandibular relation and teeth arrangement.

Materials

1- Metallic
   a. Cobalt Chromium
   b. Stainless Steel
2. Non-Metallic
   a. Acrylic resins
   b. Vinyl reins.
3. Temporary
   a. Shellac
   b. Base plate wax
   c. Auto polymerizing resins
4. Permanent
   a. Heat cure resins
   b. Light cure resins

Fabrication of occlusal rim

1) Preformed occlusal rim

2) Rolled wax technique for fabrication of occlusal rim

1- A sheet of wax is taken and softened over the flame and rolled to width of 4 mm.

2- The wax is rolled carefully to avoid entry of air bubbles and form single thick cylinder of wax.
3- Rolled cylinder wax is adapted over base plate.
4- Maxillary occlusal rims are U shaped.
5- Mandibular occlusal rims are V shaped.

Customizing occlusal rim

1) Lip support and labial fullness.
2) Overjet
3) Cheek support and buccal fullness
4) Height of occlusal plane
5) Orientation of plane of occlusion

Anteriorly: - It should be parallel to interpupillary line.
Posteriorly: - Posteriorly it should be parallel to Ala tragus line.

Dimensions

Maxillary Rim

Height Anteriorly 22 mm
Posteriorly 18mm

Width Anteriorly 4-6mm
Posteriorly 6-8 mm.

Mandibular Occlusal Rim

Height Anteriorly 18 mm
Posteriorly 2/3rd of retromolar pad
Width Anteriorly 4-6 mm
Posteriorly 8-12mm

Jaw Relation

Relation of maxilla to mandible is jaw relation.

Types:-

1) Orientation Jaw relation.
2) Horizontal Jaw Relation
    a..Centric
    b. Eccentric
3) Vertical Jaw relation
    a. Vertical dimension at rest position
    b. Vertical dimension at occlusion

Teeth selection

Anterior teeth are selected based on aesthetics and posterior teeth based on function.

Anterior teeth selection

I) Size of the teeth

(a) Methods using pre-extraction records (e.g. diagnostic cast, photographs, radiographs)

(b) H. Pounds Formula

Width of maxillary central incisor = Bizygomatic width / 16

Length of maxillary central incisor = Length of face/ 16

(c) Using Anatomical Landmarks

1. Size of maxillary arch

   The distance between incisive papilla and hamular notch on one side is added with the distance between two hamular notches. This gives combined width of all anterior and posterior teeth of maxillary arch.

2. Location of canine eminence

   The distance between two canine eminences gives combined width of all anterior teeth.

3. Location of corners of mouth

II) Form of the teeth

III) Colour of the teeth

Posterior teeth selection

I) Size of the teeth

(a) Buccolingual width

(b) Mesiodistal length
(c) Occlusogingival height

II) Form of the teeth

(a) Cusp teeth (anatomic/ semi-anatomic teeth)
(b) Cuspless teeth

Tooth Setup

Setup is arrangement of artificial teeth on denture base.
Teeth are arranged in occlusal rims which are mounted in an articulator
A small portion of the wax is scooped out with heated instrument. Teeth are arranged into the wax.

Guidelines

1- **Canine key of occlusion**
   Distal surface of lower canine should coincide with mesial arm of upper canine
2- **Molar key of occlusion**
   Mesio buccal cusp of maxillary permanent molar should coincide with mesiobuccal groove of mandibular molar. This is Class-I molar relationship.
3- **Overjet** Horizontal distance (overlap) of the maxillary central incisors over the mandibular central incisors, in occlusion. It should be 2mm.
4- **Overbi**te - It is the vertical distance(overlap) of the maxillary central incisors over the mandibular central incisors, in occlusion. It should be 0.5 mm.

Maxillary Guidelines

A line drawn on maxillary occlusal rim from midpoint of lateral incisor to tuberosity. This line represents palatal cusp of upper posterior teeth.

Mandibular Guidelines

A line drawn on lower occlusal rim corresponding to center of alveolar ridge that extends from cusp tip of canine to retromolar pad. It represents central groove of lower posterior teeth.

Maxillary Anterior Tooth Setup

The artificial teeth should be placed as near as possible to the position occupied by natural teeth.
Incisive papilla is a guide to anterior tooth position. Labial surfaces of central incisors are 8-10 mm in front of papilla.
The six teeth (3 teeth from incisors to canine from one side of the midline) in front of the maxillary arch are called anterior teeth.

Central Incisors
From front aspect: Long axis parallel to vertical axis
Side aspect: Long axis slopes labially 15°

Occlusal plane: Incisal edge **c**ontacts the occlusal plane

Lateral Incisors
From front : Long axis tilted towards midline
From Side : Slopes labially 20
Occlusal plane: 2mm above the occlusal plane

Maxillary Canines
From Front: Long axis parallel to vertical axis
From Side: Parallel to vertical axis
Occlusal plane: Cusp tip touches occlusal plane.

Mandibular Anterior tooth Setup

The six teeth in front of the mandibular arch (3 teeth from incisors to canine from one side of the midline) are anterior teeth in mandibular arch.

Central Incisors
From Front: Long axis parallel to vertical axis
From Side: Slopes labially
Occlusal Plane: 2mm above occlusal plane

Lateral Incisors
FRONT: Long axis parallel to vertical axis
SIDE: Slopes labially
Occlusal Plane. 2mm above occlusal plane.

Mandibular Canines
FRONT: Long axis tilted lingually
SIDE: Slopes mesially
Occlusal Plane: 2mm above occlusal plane

Posterior tooth Setup (Maxillary)

1st Premolar
FROM FRONT and SIDE: Parallel to vertical axis
Occlusal Plane: Buccal cusp touches occlusal plane and palatal cusp is 0.5mm above occlusal plane

2nd Premolar

FROM FRONT and SIDE: Parallel to vertical axis
Occlusal Plane: Both buccal and palatal cusps touch occlusal plane.

1st Molar
FRONT: Long axis tilted buccally
SIDE: Long axis tilted distally
Occlusal Plane: Mesio palatal cusp touches occlusal plane

2nd Molar
FRONT: Long axis tilted buccally
SIDE: Long axis tilted distally
Occlusal Plane: Mesio palatal cusp should be nearest cusp to occlusal plane

Posterior Tooth Setup (Mandibular)
1st Premolar
FRONT & SIDE: Long axis parallel to vertical axis
Occlusal Plane: Buccal cusps 2mm above occlusal Plane. Lingual cusp below occlusal plane

2nd Premolar
FRONT & SIDE: Long axis parallel to vertical axis
Occlusal Plane: Both cusps are 2mm above occlusal plane

1st Molar
FRONT: Long axis slopes lingually.
SIDE: Tilted mesially
Occlusal plane: All cusps are above the level of occlusal plane with mesial & lingual cusps lower than distal and buccal cusps.

2nd Molar
FRONT: Long axis slopes lingually
SIDE: Tilted mesially
Occlusal Plane: All cusps are above the level of 1st molar with mesial and lingual cusps being lower than distal and buccal cusps.

Wax up and Festooning

The contouring of wax base of trial denture into desired form.
The softened wax is kneaded and adapted over cervical areas of teeth.
The wax should be adapted and properly contoured before carving.
There are two methods for festooning:

1. **Press on Method** (Using sheet of wax)

2. **Drop of Method** (Using stick of wax)

Festooning:
The process of carving the denture base to simulate the contour of natural tissues that are being replaced by denture.

Gingival margins
The gingival margins are carved at 45° angle to tooth surface to give scalloped appearance.

Inter dental papilla
It is convex in shape both mesiodistally and occlusogingivally. It extends up to contact point of two adjacent teeth.

Palatal Surface
It should be of uniform thickness of 2.5mm.

Stippling
Procedure of giving the shape of orange shell to the outer surface of denture, from premolar to premolar region.

Articulator

It is an instrument that represents TMJ and Jaws to which maxillary and mandibular cast may be attached.

Uses:-

1. To hold upper and lower casts in fixed relationship.
2. To simulate jaw movements like opening and closing.
3. To arrange artificial teeth.
4. To allow prosthetic work to be done in absence of patient.

Basic parts :-

1. Upper member
2. Lower member
3. Mounting plates
4. Condylar guidance
5. Condylar element
6. Incisal guide pin
7. Incisal guide table

Classification

1.Simple hinge/ Non-adjustable

2.Semi adjustable

Arcon

Non-arcon

3. Fully adjustable articulator

SIMPLE HINGE ARTICULATOR

It consists of upper + lower member.

Upper member represents maxilla and lower member represents mandible.
The incisal pin separates the upper and lower components in anterior end.
The vertical rod rests on incisal table of lower member.

Hanau Articulator (Wide VUE Arcon)

Upper member

It is T-shaped

The anterior end of vertical arm has an incisal pin.

Condylar guidance is attached to upper member.

Lower member

The adjustable incisal guidance is present at anterior end of horizontal arm.
The upper portion of vertical arm contains roll pin.
Condylar shaft is anterior to roll pin.
Condylar element is a metal ball that represents condyle.
Condylar element is attached to lower member.
Condylar element articulates with condylar guidance.

Flasking

"It is a process of investing the cast and waxed denture in a flask to make a sectional mold used to form acrylic denture base."
The acrylic record base and wax is substituted with heat cure denture base attached to teeth.

Steps:-

1. Flasking
2. Wax elimination
3. Mixing of powder and liquid
4. Packing
5. Curing
6. De-flasking
7. Shaping & Polishing.

Flask has 3 parts:

1) Lower half (base)
2) Upper half (body)
3) Cover

Compression Technique

Lower half of flask.

Cast and wax denture is placed in lower half of flask with gypsum investment material. This is **first pour**. Cast should be immersed at center of base.

Inner surface of flask is coated with Vaseline while base of cast is painted with separating medium. After setting of first gypsum layer, separating medium is painted.

Upper half of flask

The upper half of flask is put in place and second mixture of gypsum is poured on occlusal surface. This is **second pour**. Finally top position of flask is poured with investment and lid is placed in flask This is **third pour.**

The stone is left to set completely for 45 minutes.

Curing (polymerization)

After final closure, flask is kept at room temperature for 30-60 minutes. This is Bench Curing.

Long curing cycle

Heat flask at 60-70°C for 9 hours.

Short curing cycle

Heat flask at 65°C for 9 minutes. Then boil for 1 hour for polymerization.

Cooling and Deflasking

Finishing and polishing of Denture

Trimming:-

i) Borders are trimmed using lathe or carbide bur.

ii) Frenum relief is given with fissure bur.

iii) Tissue surface nodules are removed with lathe.

iv) Uniform thickness of 2-2.5 mm must be maintained.

Finishing-

It is the processing of the final form of denture by removing any flash, stone or nodules of acrylic resin around teeth or denture base.

Polishing

It is the process of removing any scratches to make denture smooth & glossy with pumice wash.

Re-lining

It is a procedure to re-surface the tissue surface of denture with new base material. to make the denture fit more accurately.

Indications

1. When there is poor denture adaptation due to ridge resorption.
2. Patient cannot afford a new denture.

Contraindications

1. When ridge has excessively resorbed.
2. Unsatisfactory jaw relation.

Advantages

Reduce patient visits
Economical
Improves fit of denture

Disadvantages.

Cannot correct Jaw relation
Cannot be used when excessive resorption has occurred

Types of Relining.

1. Direct Relining
2. Indirect Relining

P**ROCEDURE**

Receive previous denture with cavex impression
Make model
Flasking
Dewaxing
Packing and curing
Finishing & polishing.

Immediate Denture

It is a removable denture inserted immediately following removal of natural teeth.

Advantages

1. Psychological benefit to patient.
2. Shape and height of ridge is preserved

Disadvantages

1. Expensive
2. Needs more chairside time
3. Fitting not same as conventional denture

STEPS

Alginate impression
↓
Cast
↓
Custom tray
↓
Cavex impression
↓
Occlusal rims fabricated
↓
Anterior teeth in master cast are trimmed to cervical margin and smoothened
↓
Artificial teeth are arranged over area when teeth are to be extracted
↓
Flasking
↓
Denture Insertion.

Copy Denture

Copy Denture refers to duplicate of existing denture with some modification.

Indications

1. Satisfactory position of teeth and polished surface.
2. Patient is comfortable with previous denture.
3. Deterioration of denture base material.

Advantages

1. Makes new denture without damaging old denture.
2. Time Saving
3. Less work for technician.

Disadvantages

1. Errors are difficult to correct
2. Expensive

Technique

1. Take the existing denture
2. Put the denture in flask and pour lower half of flask with alginate or putty
3. Apply the separating media and let it dry
4. Mix alginate and pour in upper half of flask
5. Press upper half of flask against lower half of flask
6. Open flask and remove denture
7. Apply cold mould seal
8. Mix white dentine and pour the teeth area of flask

9. After that mix, fill other part of flask with denture base material. Close both half of flask against each other and cure.

10. Finishing and polishing
11. Copy Denture is ready.

Over Denture

A denture that covers and rests on one or more natural teeth, roots of natural teeth. or dental implants.

Types

1.Tooth supported over-denture

2 . Implant supported over-denture

Indications

1. For better support and esthetics in morphologically compromised dental arches.
2. Cleft palate cases.
3. For congenital anomalies like microdontia, amelogenesis imperfecta, dentinogenesis imperfecta.
4. Dentures for patients with maxillofacial trauma.

Advantages

1. Maintains integrity of residual ridge.
2. Improves retention and stability of denture.
3. Psychological effect on patients as extraction can be avoided.

Disadvantages

1. High incidence of caries and periodontal disease around overdenture abutments.
2. More expensive than conventional dentures.
3. Good oral hygiene is required.

Denture Repair

Denture may fracture during function or when dropped on hard surface.
The key to repair is the accuracy of reassembling and alignment of broken parts to their original position.

Types of Repair of Complete Denture

1) Mid-line fracture Repair

2) Any part fracture Repair

3) Tooth fracture Repair

Midline Fracture Repair

1) Broken parts are assembled and fixed together with Sticky way.

2) Assembled parts may be strengthened with burs or plastic sticks.

3) Any undercut on the fitting surface is blocked out with wax or clay.

4) Fitting surface is painted with separating medium.

5) Stone plaster is poured into the fitting surface. After the stone is set the deture is removed from the cast.
6) Fractured edges are reduced, widened along the fracture line to increase the bonding surface.
7) Dove-tail cuts may be made to strengthen the repair joint.

8. Cast is painted with separating medium.

9) Self cure acrylic resin is applied on modified fracture area until the area is overfilled.

10) Finishing and polishing is done.

REMOVABLE PARTIAL DENTURE

A removable partial denture is a denture for a partially edentulous patient who desires to have replacement teeth for functional or aesthetic reasons and who cannot have a bridge for any reason, such as a lack of required teeth to serve as support for a bridge or financial limitations.

Types

1. Cast partial

a) Tooth supported
b) Tooth and tissue supported

2. Acrylic (soft tissue supported)

a) Replacing anterior teeth
Spoon denture
Every denture
b) Replacing long span edentulous arches

SOFT TISSUE SUPPORTED DENTURES REPLACING ANTERIOR TEETH

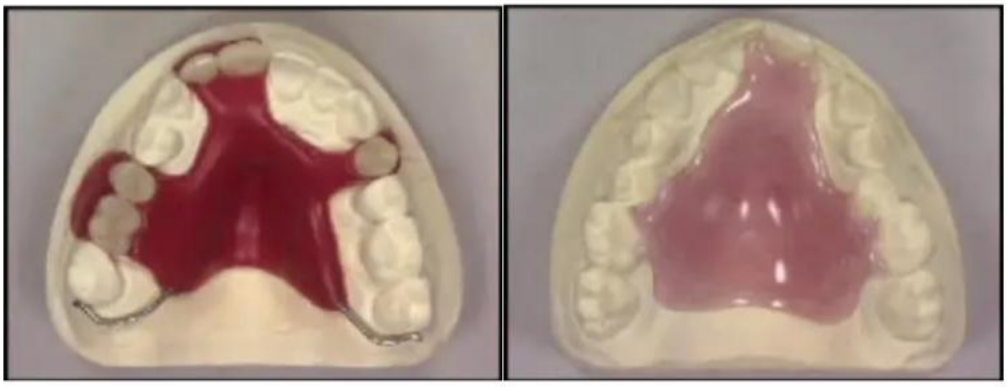
The **Spoon denture** is given in only one or two missing anterior teeth**.**

Every denture is Mucosa Born Denture and only for Upper Arch to replace one or more Teeth in Kennedy's class III cases with modification. They have no clasps for retention. The retention is achieved by restoring the contact points with the natural teeth.

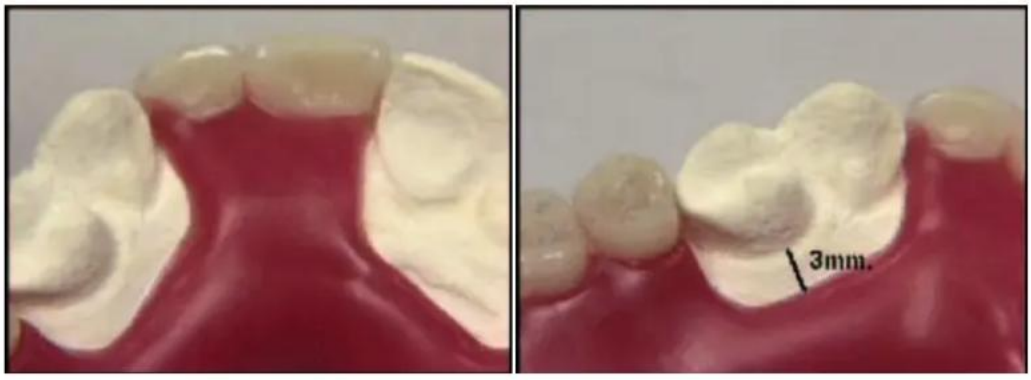
PRINCIPLES

Restoration of contact points for arch integrity

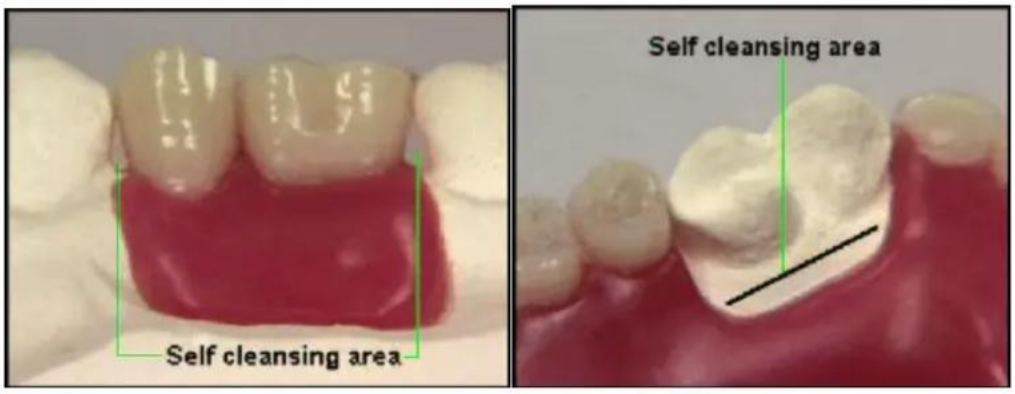
Large base extended distally for retention & support



Denture base should not encroach on gingival tissues



Wide embrasures for self cleansing



Lateral & posterior stability by flanges

Posterior stops for anterior displacement of denture not for retention

Free occlusion and no lateral contacts

SOFT TISSUE DENTURES REPLACING LONG SPAN EDENTULOUS ARCH

Multiple teeth are missing, hence wrought wire clasps are required for retention.

SCIENCE OF DENTAL MATERIALS

History of Dental Materials

Phoenicians/Egyptians 3150 BC

- “Tooth worms”
- Used gold for appliances
- Today: crowns, bridges or foils

Chinese 2700 BC

- Silver amalgam first used China
- Porcelain discovered in 1295 AD

Etruscans 6th Century BC

- Gold and teeth from oxen/calves for appliances

Romans 166-201 AD

- Skilled in manipulating gold
- Very hygienic-cleaning powders
- Tooth picks-wood, metal, gold

Italy-Mar• USA – G.V. Black 1895

- Research and study of dental materials still in effect today
- “Grand Old Man of Dentistry”
- Developed machines to test alloys, materials & instruments
- Wrote many texts
- “Extension for prevention doctrine” co Polo 1295 AD
- Trial & error-slow, wasteful
- Brought porcelain to Europe in 13th century

Properties of Dental Materials

Mechanical Properties

- Stress
- Strain

Mechanical properties based on elastic deformation

- Stress-Strain Curves
- Elastic Modulus
- Poisson’s Ratio
- Flexibility
- Resilience

Strength properties

- Proportional limit
- Elastic Limits
- Yield Strength
- Ultimate Strength
- Fracture Strength
- Elongation

Other mechanical properties

- Ductility and Malleability
- Resilience
- Toughness
- Fracture Toughness
- brittleness
- Hardness

Physical properties

- Abrasion and abrasion resistance
- Creep and flow
- Viscosity
- Tarnish and corrosion
- Density
- Solubility

Tensile Properties of Brittle Materials

- Viscoelasticity
- Fluid Behavior and Viscosity
- Viscoelastic Materials
- Creep Compliance
- Dynamic Mechanical Properties
- Dynamic Modulus

Surface Mechanical Properties

- Hardness
- Friction
- Wear
- The Colloidal State
- Nature of Colloids
- Typical Colloid Systems
- Diffusion Through Membranes and Osmotic
- Pressure
- Adsorption, Absorption, and Sorption
- Surface Tension and Wetting
- Adhesion
- Surface Considerations
- Penetration Coefficient

Optical Properties

- Color
- Measurement of Color
- Color Measuring Instrument
- Visual Method
- Surface Finish and Thickness
- Pigmentation
- Metamerism
- Fluorescence
- Opacity, Translucency, Transparency, and
- Opalescence
- Index of Refraction
- Optical Constants
- Scattering Coefficient
- Absorption Coefficient

- Light Reflectivity
- Contrast Ratio
- Masking Ability

Thermal Properties

- Temperature
- Transition Temperatures
- Heat of Fusion
- Thermal Conductivity
- Specific Heat
- Thermal Diffusivity
- Coefficient of Thermal Expansion

Electrical Properties

- Electrical Conductivity and Resistivity
- Dielectric Constant
- Electromotive Force
- Galvanism
- Electrochemical Corrosion
- Zeta-Potential

Other properties

- Water Sorption
- Setting Time
- Shelf Life

Summary: In the oral environment, restorative materials are exposed to chemical, thermal, and mechanical challenges. These challenges can cause deformation of the material. The science that studies how biological materials interact and deform is called biomechanics.

Occlusal Forces

- A force is defined by three characteristics: point of application, magnitude, and direction of application.
- The International System of Units (SI) unit of force is the Newton (N).
- Maximum occlusal forces range from 200 to 3500 N.

- Occlusal forces between adult teeth are highest in the posterior region closest to the mandibular hinge axis.

Stress

When a force acts on a constrained body, the force is resisted by the body. This internal reaction is equal in magnitude and opposite in direction to the applied external force, and is called stress, typically denoted as S or σ.

Strain

Each type of stress is capable of producing a corresponding deformation in a body.

Elongation

The deformation that results from the application of a tensile force is elongation.

Ductility and Malleability

Two significant properties of metals and alloys are ductility and malleability.

- The ductility of a material represents its ability to be drawn and shaped into wire by means of tension. When tensile forces are applied, the wire is formed by permanent deformation.
- The malleability of a substance represents its ability to be hammered or rolled into thin sheets without fracturing.

Resilience

- Resilience is the resistance of a material to permanent deformation. It indicates the amount of energy necessary to deform the material to the proportional limit.

Toughness

It is the resistance of a material to fracture and is an indication of the amount of energy necessary to cause fracture.

Fluid Behavior and Viscosity

Many dental materials, such as cements and impression materials, are in the fluid state when formed.

Viscosity (η) is the resistance of a fluid to flow. When a cement or impression material sets, the viscosity increases, making it less viscous and more solid-like.

Dynamic Modulus

The dynamic modulus (ED) is defined as the ratio of stress to strain for small cyclical deformations at a given frequency and at a particular point on the stress-strain curve.

Hardness

The resistance to permanent surface indentation or penetration.

Friction

Friction is the resistance between contacting bodies when one moves relative to another.

Wear

Wear is a loss of material resulting from removal and relocation of materials through the contact of two or more materials.

Measurement of Color

The color of dental restorative materials is most commonly measured in reflected light using a color measuring instrument or a visual method.

Opacity, Translucency, Transparency, and Opalescence

The color of an object is modified not only by the intensity and shade of the pigment or coloring agent but also by the translucency or opacity of the object. Hard and soft tissues vary in their degree of opacity. Most exhibit some translucency. This is especially true of tooth enamel and the surrounding gingival tissues.

Opacity is a property of materials that prevents the passage of light.

Translucency is a property of substances that permits the passage of light but disperses the light, so objects cannot be seen through the material. Some translucent materials used in dentistry are ceramics, resin composites, and acrylics.

Opalescent materials, such as dental enamel, are able to scatter shorter wavelengths of light.

Thermal Conductivity

The thermal conductivity, K, of a substance is the quantity of heat in calories, or joules, per second passing through a body 1-cm thick with a cross-section of 1 cm2 when the temperature difference is 1° C. The units are cal/sec/cm2/(° C/cm).

Specific Heat

The specific heat, Cp, of a substance is the quantity of heat needed to raise the temperature of 1 g of the substance 1° C. W

Thermal Diffusivity

It is a measure of transient heat-flow and is defined as the thermal conductivity, K, divided by the product of the specific heat, Cp, times the density, ρ: Δ = K / (Cp p)

The units of thermal diffusivity are mm2/sec.

Other Properties

Certain properties often are highly important in the selection and manipulation of materials for use either in the mouth or for laboratory applications. Five such properties are tarnish and discoloration, water sorption, solubility and disintegration, setting time, and shelf life.

Tarnish and Discoloration

Discoloration of a restorative material from any cause is a very troublesome quality. The tarnish of metal restorations from oxide, sulfide, or any other materials causing a surface reaction is a critical quality of metal restorations in the mouth and of laboratory and clinical instruments.

Water Sorption

Water sorption of a material represents the amount of water adsorbed on the surface and absorbed into the body of the material during fabrication or while the restoration is in service.

SUMMARY

The physical properties of oral restorations must adequately withstand the stresses of mastication. Several methods may be used to ensure proper performance of a restoration. With a constant force, the stress is inversely proportional to the contact area; therefore, stresses may be reduced by increasing the area over which the force is distributed. In areas of high stress, materials having high elastic moduli and strength properties should be used if possible. If a weaker material has desirable properties, such as esthetic qualities, one may minimize the stress by increasing the bulk of the material when possible.

IMPRESSION MATERIALS

Definition of impression materials

Impression materials are used to register or reproduce the form and relationship of the teeth and oral tissues.

Classification of Impression Materials

*1.*On the basis of mode of setting

- Set by chemical reaction(irreversible)
- Set by temperature change(reversible)

*2.*On the basis of elasticity

- Elastic
- Non elastic/Rigid

Elastomeric impression materials

1. Hydrocolloids
    - Agar
    - Alginate
2. Non aqueous elastomers

    - Polysulphides
    - Polyether
    - Addition silicones
    - *Condensation silicones*

Non elastic /rigid impression materials

- Impression plasters
- Impression compound
- Impression waxes
- Zinc oxide eugenol

Hydrocolloids and synthetic elastomeric polymers are among the materials most commonly used to make impressions of various areas of the dental arch. Each of these classes of materials has certain advantages and disadvantages.

PURPOSE OF IMPRESSION MATERIALS

Impression materials are used to make an accurate replica or mold of the hard and soft oral tissues. The area involved may vary from a single tooth to the whole dentition, or an impression may be made of an edentulous mouth. The impression is a negative reproduction of the tissues, and by filling the impression with dental stone or other model material, a positive cast is made that can be removed after the model material has set.

DESIRABLE QUALITIES

The desirable properties of an impression can be summarized briefly as follows:

1. A pleasant odor, taste, and acceptable color

2. Absence of toxic or irritant constituents

3. Adequate shelf life for requirements of storage and distribution

4. Economically commensurate with the results obtained

5. Easy to use with the minimum of equipment

6. Setting characteristics that meet clinical requirements

7. Satisfactory consistency and texture

8. Readily wets oral tissues

9. Elastic properties that allow easy removal of the set material from the mouth and good elastic recovery

10. Adequate strength to avoid breaking or tearing upon removal from the mouth

11. Dimensional stability over temperature and humidity ranges normally found in clinical and laboratory procedures for a period long enough to permit the production of a cast or die

12. Compatibility with cast and die materials

13. Accuracy in clinical use

14. Readily disinfected without loss of accuracy

15. No release of gas or other byproducts during the setting of the impression or cast and die materials

TYPES OF IMPRESSION MATERIALS

Alginate hydrocolloid and elastomeric impression materials are the most widely used today, and the properties of these are examined first

ALGINATE HYDROCOLLOIDS

Dental alginate impression materials change from the sol phase to the gel phase because of a chemical reaction. Once gelation is completed, the material cannot be re-liquefied to a sol. These hydrocolloids are called irreversible to distinguish them from the agar reversible hydrocolloids.

Alginate impression products have acceptable elastic properties. Preparation for use requires only the mixing of measured quantities of powder and water. The resulting paste flows well and registers acceptable anatomical detail. Gypsum casts and models are made by pouring dental plaster or stone into the impression; no separating medium is necessary. The powder is supplied in bulk containers along with suitable measures for dispensing the correct quantities of powder and water. The powder is also available in small sealed packets containing a quantity suitable for a single impression and ready for mixing with a measured quantity of water. These methods of packaging, together with the measuring devices supplied by the manufacturer.

ELASTOMERIC IMPRESSION MATERIALS

Four types of synthetic elastomeric impression materials are available to record dental impressions.

- Polysulfides
- Condensation silicones
- Addition silicones (polyvinylsiloxanes)
- Polyethers.

GYPSUM PRODUCTS

Gypsum products probably serve the dental profession more adequately than any other materials. Dental plaster, stone, high-strength/high-expansion stone, and casting investment constitute this group of closely related products.

With slight modification, gypsum products are used for several different purposes. For example, impression plaster is used to make impressions of edentulous mouths or to mount casts, whereas dental stone is used to form a die that duplicates the oral anatomy when poured into any type of impression. Gypsum products are also used as a binder for silica in gold alloy casting investment, soldering investment, and investment for low-melting-point nickel-chromium alloys. These products are also used as a mold material for processing complete dentures. The dihydrate form of calcium sulfate, called gypsum, usually appears white to milky yellowish. The mineral gypsum has commercial importance as a source of plaster of Paris.

CHEMICAL AND PHYSICAL NATURE OF GYPSUM PRODUCTS

Gypsum is the dihydrate form of calcium sulfate ($CaSO_4 \cdot 2H_2O$). On heating, it is converted to calcium sulfate hemihydrate, ($CaSO_4 \cdot \frac{1}{2}H_2O$), sometimes written $(CaSO_4)_2 \cdot H_2O$. When calcium sulfate hemihydrate is mixed with water, the reverse reaction takes place, and the calcium sulfate hemihydrate is converted back to calcium sulfate dihydrate.

CASTING INVESTMENTS

The adoption of the casting practice in dentistry for making gold alloy inlays, crowns, bridges, and other restorations represents one of the major advances in restorative dentistry.

Properties Required of an Investment

1. Easily manipulated: Not only should it be possible to mix and manipulate the mass readily and to paint the wax pattern easily, but the investment should also harden within a relatively short time.
2. Sufficient strength at room temperature: The investment should permit ease in handling and provide enough strength at higher temperatures to withstand the impact force of the molten metal. The inner surface of the mold should not break down at a high temperature.
3. Stability at higher temperatures: Investment must not decompose to give off gases that could damage the surface of the alloy.

4. Sufficient expansion: It must expand enough to compensate for shrinkage of the wax pattern and metal that takes place during the casting procedure.
5. Beneficial casting temperatures: Preferably the thermal expansion versus temperature curve should have a plateau of the thermal expansion over a range of casting temperatures.
6. Porosity: It should be porous enough to permit the air or other gases in the mold cavity to escape easily during the casting procedure.
7. Smooth surface: Fine detail and margins on the casting should be preserved.
8. Ease of divestment: The investment should break away readily from the surface of the metal and should not have reacted chemically with it.
9. Inexpensive

DENTAL WAXES

The primary use of waxes in dentistry is to make a pattern of appliances prior to casting as many dental restorations are made by lost-wax technique, in which a pattern is made in wax and put in the mold (investment materials). After setting, the wax is burnt out and the space is filled with molten metal or plastic acrylic. Chemically waxes are polymers consisting of hydrocarbon and their derivatives like ester and alcohol. Dental waxes are mixture of natural and synthetic waxes gums, fat, oils, natural and synthetic resins and coloring agents.

Requirements of dental waxes

1. Must conform to the exact size and shape and contour of the appliance which is to be made

2. Should have enough flow when melted to reproduce the fine details.

3. No dimensional changes should take place once it is formed.

4. Boiling out of the wax without any residue.

5. Easily carved and smooth surface can be produce.

Classification of waxes:

According to origin:

1. Mineral
   a. Paraffin: Refined from crude oil, has relatively low melting point (50-70°C) and relatively brittle.
   b. Ceresin: Refined from petroleum, has medium melting range (60°C).

2. Plants:
   a. Carnauba: Obtained from palm trees, it is hard, tough, and has high melting point (80-85°C).
   b. Candelilla: It is hard, tough, and has high melting point (80-85°C), used to increase the melting point and reduce flow at mouth temperature.
   3. Animal:
   a. Stearin: Obtained from beef fat, has low melting point (50 C).

   b. Bees: Obtained from honey-comb, consist of partially crystalline natural polyester. It is brittle, has medium melting temperature (60-70°C).

4- Synthetic:
They are used to modify some properties of natural waxes like polyethylene.

According to use:

1. Pattern wax

a. Inlay wax:

It should be hard and brittle in order to fracture rather than to distort when removal from undercut areas. The wax is blue in color. They are used to make inlays, crowns and pontic replicas. They are mostly paraffin with carnauba wax. There are two types:
Type 1: for direct technique.
Type2:For indirect technique .

b. Denture casting wax:
It is used to produce the metal components of cobalt/chromium partial denture.
It is based on paraffin wax with bees' wax to give softness necessary for molding and stickiness necessary to ensure adhering to an investment cast material of refractory cast.
It is green in color

c. Denture base plate wax:
It is used to form the base of the denture and in setting of teeth.
It is pink in color

2. Processing wax

Waxes are used during processing of the appliance.

a. Beading: It is used to make beading around the impression before pouring gypsum to protect the margins of the cast.

b. boxing: it is used to make box around the impression to make pouring gypsum into the impression easier and more perfect.

c. Block out: It is used to block out undercut areas on cast during processing of co/cr metal framework. d. White: It is used to make pattern simulate veneer facing in crowns.

e: sticky: it is used to join and stabilize temporary broken pieces of the broken denture before repair.

3. Impression wax

They are previously used to make impression, but they distort when removal from undercut areas, they have high flow.

a. Impression wax: It is used to make the impression.

b. Corrective wax: It is used to record selected areas of soft tissues in edentulous arches.

Properties

1. They are thermoplastic materials that are soft when heated and are solid at room temperature.

2. They have high coefficient of thermal expansion and contraction. Thermal contraction of wax is compensated by expansion of investment.

3. They are poor thermal conductivity. The best way to soften the wax is to be held in the warm raising air above the flame and not in the flame itself.

4. They should have high flow when softened, but should little or no flow at room temperature or mouth temperature in order not to distort.

SEPERATING MEDIUM

1. A material applied to a cast to facilitate separation from the resin denture base material after curing and to protect the resin from the moisture in the gypsum, such as tinfoil, cellophane, or alginate.

2. A material applied to the fitting surface of an implant-retained denture during its construction to prevent material bonding to the denture base.

Selection Of Separating Medium

Used to separate the denture base material from the mould surface
Formerly tin foil was used but it was a time consuming and difficult process
Causes: dimensional inaccuracy and poor reproduction of details

Tin foil substitutes

- Cellulose lacquers
- Evaporated milk
- Solution of alginate compounds
- Soap
- Sodium silicate
- Starch

Most commonly used are the water soluble alginates

EQUIPMENT USED IN DENTAL LAB

- Workbenches and lighting,
- utility equipment including dust collectors and compressors.
- handpiece
- An articulation system for mounting models and cases
- cleaning and polishing systems for putting those final touches on restorations
- Another category of dental lab equipment that can be put to use in almost any lab is a cad/cam system.
- waxing equipment
- casting equipment.
- Labs that plan to work with ceramic materials will need the right furnace to match the materials being used. If your lab plans to specialize in removable restorations such as dentures the equipment you will need is different because you will be working with a different set of materials and processes.
- Removable labs need to invest in systems designed for working with acrylic materials, and the equipment for curing these materials is critical as well. Regardless of the specialties of your lab, investing in the right equipment requires more than simply purchasing the correct systems.

Soldering and Welding

- Soldering is the process of joining pieces of metal using a molten filler metal, known as solder. The processing temperature of the filler metal is below the solidus point of the alloys to be joined. The solder wets these alloys but does not melt them during soldering.

- Soldering is distinguished from welding by the use of a third body, the solder, between the two workpieces, but without melting either of them. The conditions for effective joins of these types are discussed.

- All of this also depends on the cleanliness of the substrate metal. Oxides, sulphides and many other possible contaminants cannot be wetted by solders (*cf.* mercury and amalgam alloys; casting alloys and investments). It is essential therefore to ensure that both surfaces to be soldered (or welded, for that matter) are scrupulously clean, initially by degreasing and then abrasion or filing. Even so, surface oxidation may be so rapid when the workpieces are heated as still to preclude effective wetting or wetting over a sufficient area. This is where fluxes come in.

FLUXES

- The word **flux** means flow, and in the present context means flow of the molten solder being achieved by allowing or facilitating the wetting of the substrate.
- The function of fluxes therefore is twofold.

  (1) To remove any oxides or other compounds present on the surface, and

  (2) To prevent further oxidation by excluding oxygen from the site, purely as a physical barrier.

METALS

- Amalgam
- Dental Casting Alloy
- Base Metal Alloys

AMALGAM

An amalgam is an alloy of mercury and one or more other metals. Dental amalgam is produced by mixing liquid mercury with solid particles of an alloy containing predominantly silver, tin, and copper. Zinc and palladium may also be present in small amounts. This combination of solid metals is known as amalgam alloy. It is important to differentiate between dental amalgam and the amalgam alloy that is commercially produced and marketed as small filings, spheroid particles, or a combination of these, suitable for mixing with liquid mercury to produce the dental amalgam. Once amalgam alloy is freshly mixed with liquid mercury, it has the plasticity that permits it to be conveniently packed or condensed into a prepared tooth cavity. After condensing, the dental amalgam is carved to generate the required anatomical features and then hardens with time. Amalgam is used most commonly for direct, permanent, posterior restorations and for large foundation restorations, or cores, which are precursors to placing crowns. Dental amalgam restorations are reasonably easy to insert, are not overly technique sensitive, maintain anatomical form, have reasonably adequate resistance to fracture, prevent marginal leakage after a period of time in the mouth, can be used in stress-bearing areas, and have a relatively long service life. The principal disadvantage of dental amalgam is that its silver color does not match tooth structure. In addition, amalgam restorations are somewhat brittle, are subject to corrosion and galvanic action, may demonstrate a degree of breakdown at the margins of tooth and amalgam, and do not help retain weakened tooth structure. Finally, there are regulatory concerns about amalgam being disposed of in the wastewater. Despite these shortcomings, dental amalgam is a highly successful restorative material.

DENTAL ALLOYS

Various elements are combined to produce alloys with adequate properties for dental applications because none of the elements by themselves have properties that are suitable. These alloys may be used for dental restorations as cast alloys or may be manipulated into wire or other wrought forms. The metallic elements that make up dental alloys can be divided into two major groups, the noble metals and the base metals.

BASE-METAL ALLOYS

Base-metal alloys are used extensively in dentistry for a variety of restorations and instruments. Cast cobalt-chromium alloys have been used for many years for fabricating removable dental prosthesis frameworks and have replaced type IV gold alloys almost completely for this application. Nickel-chromium and cobalt-chromium alloys are used in ceramic-metal restorations.

General Requirements of a Dental Base-Metal Alloy

The metals and alloys used as substitutes for noble alloys in dental restorations must possess certain minimal fundamental characteristics:

1. The alloy's chemical nature should not produce harmful toxicological or allergic effects in the patient or the operator.
2. The chemical properties of the prosthesis should provide resistance to corrosion and physical changes when in the oral fluids.
3. The physical and mechanical properties, such as thermal conductivity, melting temperature, coefficient of thermal expansion, and strength, should all be satisfactory, meeting certain minimum values and being variable for various prostheses.
4. The technical expertise needed for fabrication and use should be feasible for the average dentist and skilled technician.
5. The metals, alloys, and companion materials for fabrication should be plentiful, relatively inexpensive, and readily available, even in periods of emergency.

DENTAL CASTING ALLOYS

Fluctuations in the price of gold, platinum, and palladium influence the selection of alloys for cast restorations. Each alloy has specific physical and mechanical properties that affect its manipulation and application. Tooth preparation and restoration design will determine the required physical and mechanical properties of the alloy, so all factors should be kept in mind during the process of treatment planning.

Types and Composition

The ADA specification for dental casting alloys classifies alloys by composition, dividing alloys into three groups: (1) high-noble, with a noble metal content of at least 60 wt% and a gold content of at least 40%; (2) noble, with a noble metal content at least 25% (no stipulation for gold); and (3) predominately base metal, with a noble metal content less than 25%

Thus a high-noble alloy might be type I or type IV, depending on its mechanical properties.

This situation is somewhat confusing, because in the old specification the alloy type was tied to its composition and virtually all alloys were gold based. In the current system, each type of alloy is recommended for intraoral use based on the amount of stress the restoration is likely to receive.

Alloy types I and II have high elongation and are therefore easily burnished, but are appropriate only in low-stress environments, such as inlays that experience no occlusal forces.

Type IV alloys are to be used in clinical situations where very high stresses are involved, such as long-span, fixed dental prostheses.

Type III alloys are the most commonly used in dental practices.

DENTAL CERAMICS

The term ceramic refers to any product made from a nonmetallic inorganic material usually processed by firing at a high temperature to achieve desirable properties. The more restrictive term porcelain refers to a specific compositional range of ceramic materials originally made by mixing kaolin (hydrated aluminosilicate), quartz (silica), and feldspars (potassium and sodium aluminosilicates), and firing at high temperature. Dental ceramics for metal-ceramic restorations belong to this compositional range and are commonly referred to as dental porcelains.

CLASSIFICATION

Classification by application

Ceramics have two major applications in dentistry:

(1) ceramics for metal-ceramic crowns and fixed partial prostheses,

(2) all-ceramic crowns inlays, onlays, veneers, and fixed partial prostheses.

Additionally, ceramic orthodontic brackets, dental implant abutments, and ceramic denture teeth are available.

Classification by Fabrication.

The most common fabrication technique for metal ceramic restorations is called sintering. Sintering is the process of firing the compacted ceramic powder at high temperature to ensure optimal densification.

All-ceramic restorations can also be produced by sintering, but they encompass a wider range of processing techniques, including slip-casting, heat-pressing, and CAD/CAM machining. Some of these techniques, such as machining and heat-pressing, can also be combined to produce the final restoration.

Classification by Crystalline Phase.

Regardless of their applications or fabrication technique, after firing, dental ceramics are composed of a glassy (or vitreous) phase and one or more crystalline phases, together with various amounts of porosity. Depending on the nature and amount of crystalline phase and porosity present, the mechanical and optical properties of dental ceramics vary widely. Increasing the amount of crystalline phase may lead to crystalline reinforcement and increase the resistance to crack propagation but also can decrease translucency.

STERILIZATION

ASEPTIC TECHNIQUES

Terminology

Sepsis: Breakdown of living tissue by the action of microorganisms and is usually accompanied by inflammation.

Medical asepsis: The attempt to keep patients, health care staff, and objects as free as possible of agents that cause infection.

Antiseptic and disinfectant: Both refer to substances that can prevent the multiplication of organisms capable of causing infection. The difference is that antiseptics are applied to living tissue, whereas disinfectants are designed only for use on inanimate objects.

Sterility: Freedom from viable forms of microorganisms.

Sanitization: Reduction of the number of viable microorganisms to levels judged safe by public health standards.

Decontamination: Similar to sanitization, except that it is not connected with public health standards.

Sterilization: Process of getting sterility (Complete destruction of all forms of microbial life).

Techniques of Instrument Sterilization:

The three methods generally available for instrument sterilization are:

- Dry heat
- Moist heat
- Ethylene oxide gas.

Dry Heat

Dry heat is a method of sterilization that can be provided in most dental offices.

Dry heat is most commonly used to sterilize glassware and bulky items that can withstand heat but are susceptible to rust.

The success of sterilization depends not only on attaining a certain temperature but also on maintaining the temperature for a sufficient time.

The advantages of dry heat are the relative ease of use and the unlikelihood of damaging heat-resistant instruments.

The disadvantages are the time necessary and the potential damage to heat sensitive equipment.

Moist heat.

Moist heat sterilization is more efficient than dry heat for sterilization because it is effective at much lower temperatures and requires less time.

The container usually used for providing steam under pressure is known as an autoclave. The autoclave works by creating steam and then, through a series of valves, increases the pressure so that the steam becomes super-heated.

Instruments placed into an autoclave should be packaged to allow the free flow of steam around the instruments, such as by placing them in sterilization pouches or wrapping them in cotton cloth.

Temperatures attainable by steam under pressure include 109°C at 5 psi, 115°C at 10 psi, 121°C at 15 psi, and 126°C at 20 psi.

The advantages of sterilization with moist heat are its effectiveness, speed, and the relative availability of autoclaving equipment.

Disadvantages include the tendency of moist heat to dull and rust instruments, and the cost of autoclaves.

Sterilization with Gas

Certain gases exert a lethal action on bacteria by destroying enzymes and other vital biochemical structures. Of the several gases available for sterilization, ethylene oxide is the most commonly used. Ethylene oxide is a highly flammable gas, so it is mixed with carbon dioxide or nitrogen to make it safer to use.

At 50°C ethylene oxide is effective for killing all organisms, including spores, within 3 hours.

The advantages of ethylene oxide for sterilization are its effectiveness for sterilizing porous materials, large equipment, and materials sensitive to heat or moisture.

The disadvantages are the need for special equipment, and the length of sterilization and aeration time necessary to reduce tissue toxicity. This technique is rarely practical for dental use.

Techniques of Instrument Disinfection

Many dental instruments cannot withstand the temperatures required for heat sterilization. Therefore, if sterilization with gas is not available and absolute sterility is not required, chemical disinfection can be performed.

Substances acceptable for disinfecting dental instruments include glutaraldehyde, iodophors, chlorine compounds, and formaldehyde; glutaraldehyde-containing compounds are the most commonly used.

Certain procedures must be followed to ensure maximal disinfection.

- The agent must be properly reformulated and discarded periodically.
- Instruments must remain in contact with the solution for the designated period, and no new contaminated instruments should be added to the solution during that time. All instruments `must be washed free of blood or other visible material before being placed in the solution.
- Finally, after disinfection the instruments must be rinsed free of chemicals and used within a short time.

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References

1) Fuller's Concise Dental Anatomy and Tooth Morphology by James L. Fuller. 3rd edition.
2) Preclinical Manual of Prosthodontics by S Lakshmi. 3rd edition.
3) Craig's Restorative Dental Materials. By Ronald L. Sakaguchi