

Tooth Morphology & Physiology

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Editor

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Ainshams University



Ain Shams University, an institute of higher education located in Cairo, Egypt. Founded in 1950, the university provides education at the undergraduate, graduate and post-graduate levels.

Ain Shams University, was founded in July 1950, making it the third-oldest non-sectarian native public Egyptian university (ancient Islamic universities such as Al-Azhar and private institutions such as the American University in Cairo are older),

In 1950, there were only eight faculties: faculties of Arts, Law, Commerce, Science, Engineering, Medicine, Agriculture, in addition to Women's college. In 1969, the faculty of Education, known since 1880 as Teachers' college, became the ninth faculty in the university. In 1973 the faculty of Al-Asun was made the tenth member in the university. In 1994, a decree was issued for the establishment of two more faculties; the faculty of Pharmacy and the faculty of Dentistry, the actual study was started the following year in both faculties.

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TOOTH MORPHOLOGY

Teeth are more than projection in the mouth that allow you to grind the food and prepare it for the initial phase of digestive process, nor do they merely serve for a limited time before ending between the claws of an extracting forceps.

, man, like most mammals is supplied through his life by two sets of teeth, a deciduous or primary set, followed by a permanent set. They are permanent teeth and it is your future responsibility to see that they remain permanent.

Teeth are one of the most important elements of the masticatory system. The student is expected to thoroughly know and understand the basic external morphology of every tooth, as well as, their proper arrangement and relation to each other and their relation to fixed points in the skull and the mandible.■

Dental Formula & Coding Systems

Dental Arches and Quadrants

The twenty deciduous teeth in the young mouth and the thirty two permanent teeth in the adult mouth are arranged in two arches called the "*Dental Arches*", one upper and one lower. Each arch contains half of the number of the teeth (10 deciduous then later 16 permanent teeth). (Fig. 1)

The upper jaw is called the "*Maxilla*" and the teeth in this arch is called the "*Upper of Maxillary Teeth*". On the other hand, the lower jaw is called the "*Mandible*" and the teeth in this arch is called the "*Lower or Mandibular Teeth*".

The imaginary vertical line which equally divides the body into right and left halves is called the midline or the "*Midsagittal Plan*". This line also divides each dental arch into right and left segments, referred to as "*Quadrants*". The permanent teeth and the deciduous teeth are equally arranged into four quadrants, as follows:

- Upper right quadrant or Maxillary right quadrant.

- Upper left quadrant or Maxillary left quadrant.
- Lower left quadrant or Mandibular left quadrant.
- Lower right quadrant or Mandibular right quadrant.

Types and Forms of Teeth

Teeth vary in form, this variation reflects differences in function. Based on forms and functions the teeth are classified into incisors, canines, premolars and molars. (Fig. 1)

- **Incisors:** They are the four front teeth in each arch. The *Central incisor* is the first tooth next to the midline. The *Lateral Incisor* is the second. The form of the incisors is more or less similar to a chisel., which makes them suitable for cutting of incising food. The side of the tooth toward the tongue, the lingual surface, is shaped like a shovel, to aid in guiding the food into the mouth.
- **Canine (*Cuspid*):** It is the third tooth from the midline. The canine

is cone or wedge shape and it is designed to function as a holding or grasping teeth suitable for piercing, cutting and tearing.

- **Premolars (Bicuspid):** They are the fourth and fifth tooth from the midline. The fourth tooth is the *First Premolar*, the fifth tooth is the *Second Premolar*. These teeth are characterized by the presence of at least two projections (cusps), a wedge-shaped projection similar to that of the canine, and a slightly rounded projection. Because of their intermediate form and location between canine and molars, they also have an intermediate function of tearing and grinding food.
- **Molars:** These are the sixth, seventh and eighth tooth from the midline. The sixth is the *First Molar*, the seventh is the *Second Molar* and the eighth is the *Third Molar*.

Molar or wisdom tooth. The molars are characterized by wide surface with multiple projections (cusps) and therefore are suitable for grinding food.

Grouping of Teeth

The teeth in the dental arch can be grouped into

- Anterior teeth: including the incisors and canines
- Posterior teeth: including the premolars and molars.

Functions of Teeth

- **Mastication:** it is the most important function of the teeth. The teeth are designed to perform this function, accordingly the incisors are designed for cutting, the canines for tearing and holding, premolars for grinding and holding and molars for grinding and chewing.
- **Appearance:** well arranged clean teeth with proper alignment give nice appearance to the face and also support the facial expressions.
- **Speech:** The teeth are important for clear pronunciation and for production of sound.
- **Growth of Jaws:** The teeth play a role in the growth of the jaws during some periods of the facial growth.
- **In Animals:** The first function of teeth is to hold food and kill prey mechanically, as the lion, or by chemical poisons, as vipers. Other animals use their teeth in combat as weapons in the struggle for existence. ■

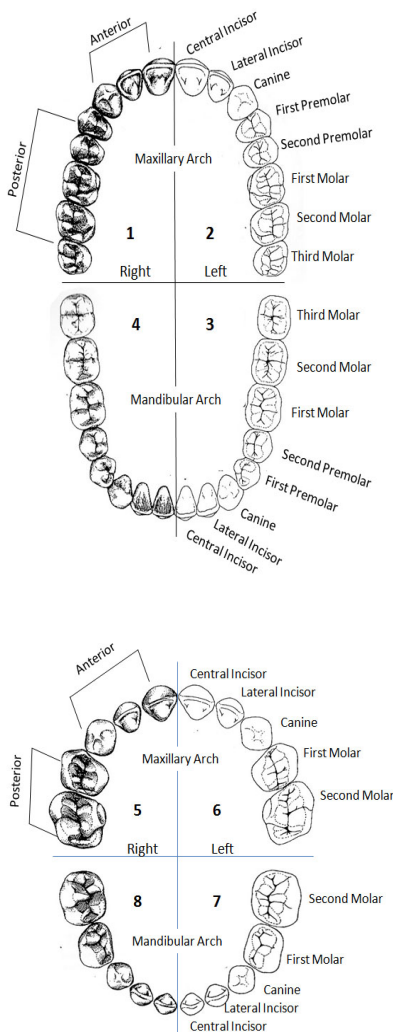


Fig. 1. The permanent dental arches (Left) and the deciduous dental arches (Upper)

The Dental Formula

The number and type of teeth for all mammal are expressed by the dental formula. The type of each tooth is represented by its initial letter:

- **I:** Incisors
- **C:** Canines
- **P:** Premolars
- **M:** Molars

Each letter is followed by a horizontal line and the number of each type of teeth is placed above the line for maxillary half and below it for the mandibular half. A typical mammalian dentition is composed of 44 teeth. This is well represented in pigs, where 22 teeth are present in each jaw (3 incisors, 1 canine, 4 premolars and 3 molars), i.e. the dental formula is: $I3/3, C1/1, P4/4, M3/3$, which is equal to 22 teeth on each side of the mouth.

- The human deciduous teeth are 20 in number and are expressed by the following formula: $I2/2 - C1/1 - M2/2 = 10$ teeth on jaw
- The human permanent teeth are 32 in number and is expressed in the following formula: $I2/2 - C1/1 - P2/2 - M3/3 = 16$ teeth for jaw

Numbering and Coding Systems of Teeth

When identifying a specific tooth, list the dentition, arch, quadrant and tooth name in that order. An example is shown in table I.

It is essential to be familiar with the various systems of naming and coding

teeth. The most popular systems are universal system, Palmer notation system and the Federation Dentaire International (FDI) system.

- **Universal System:** This system uses the Arabic numbers 1 through 32 for the permanent teeth and the letters A through T for the deciduous teeth. The number (1) is assigned to the most posterior upper right permanent tooth (the permanent maxillary right third molar). The highest number is given to the most posterior lower right tooth (the permanent mandibular right third molar). On the same way, the letter A is given to the most posterior lower right deciduous tooth (the upper deciduous right second molar) and the letter T to the most posterior deciduous lower right tooth (the lower deciduous right second molar). (Fig. 2)
- **Palmer Notation System:** In this system each of the four quadrants of the mouth is given its own symbol. A cross is drawn, the horizontal line of which separates the max-

Table I. Identifying a specific tooth

Dentition	Permanent	Deciduous
Arch	Maxillary	Mandibular
Quadrant	Right	Left
Tooth	Lateral Incisor	Canine

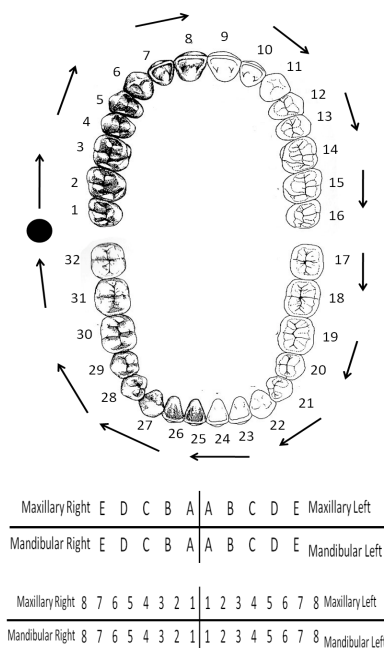


Fig. 3. Plomer notation system. Deciduous teeth (upper) and permanent teeth (lower)

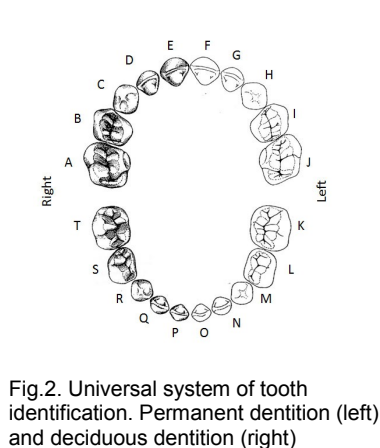


Fig. 2. Universal system of tooth identification. Permanent dentition (left) and deciduous dentition (right)

Table II. Various tooth Identification systems

		TOOTH	Tooth Identification System					
			Universal		Palmer		FDI	
			Right	Left	Right	Left	Right	Left
Deciduous Dentition	Maxilla	Central Incisor	E	F	A	A	51	61
		Lateral Incisor	D	G	B	B	52	62
		Canine	C	H	C	C	53	63
		First Molar	B	I	D	D	54	64
		Second molar	A	J	E	E	55	65
	Mandible	Central Incisor	P	O	A	A	81	71
		Lateral Incisor	Q	N	B	B	82	72
		Canine	R	M	C	C	83	73
		First Molar	S	L	D	D	84	74
		Second molar	T	K	E	E	85	75
Permanent Dentition	Maxilla	Central Incisor	8	9	1	1	11	21
		Lateral Incisor	7	10	2	2	12	22
		Canine	6	11	3	3	13	23
		First Premolar	5	12	4	4	14	24
		Second Premolar	4	13	5	5	15	25
		First Molar	3	14	6	6	16	26
		Second Molar	2	15	7	7	17	27
		Third Molar	1	16	8	8	18	28
	Mandibular	Central Incisor	25	24	9	9	41	31
		Lateral Incisor	26	23	10	10	42	32
		Canine	27	22	11	11	43	33
		First Premolar	28	21	12	12	44	34
		Second Premolar	29	20	13	13	45	35
		Frist Molar	30	19	14	14	46	36
		Second Molar	31	18	15	15	47	37
		Thrid Molar	32	17	16	16	48	38

also by numbers from 1-to-5, where 1 is the central incisor and 5 is the second molar. Accordingly the deciduous (upper) and permanent (lower) dentitions is represented as figure 4.■

Morphological & Structural Features of Teeth

Macro Anatomy of Teeth

Each tooth has “Crown” and “Root” portion. The crown is covered with enamel and the root is covered with cementum. The root is embedded in the jaw bones. The crown and root joined at the “Cementoenamel Junction”. The line demarcate this junction is called the “Cervical Line”. (Fig 5)

Crown and Root of the Tooth

- **Anatomical Crown:** is that portion of the tooth which is covered by enamel.
- **Clinical Crown:** Is that portion of the tooth which is visible in the mouth regardless whether or not it corresponds to the anatomical crown in length, as the clinical crown may change its length through life.
- **Anatomical Root:** It is that portion of the tooth which is covered by cementum.
- **Clinical Root:** It is that portion of the tooth which is not visible in the mouth. As with the clinical crown the clinical root may change its length throughout life.

Forms of the Root

The teeth may have single root, double roots or treble roots.

- **Single Root:** All the anterior teeth and the premolar teeth, except the upper first premolar, are single rooted teeth.

- **Double Roots:** There is a bifurcation, dividing the root portion into two extensions or roots as found in lower molars and upper first premolar.
- **Treble Roots:** There is a trifurcation dividing the root portion into three roots as the case in upper molars.

The undivided portion of the root is called the “trunk”. The root portion of the tooth is held in its position relative to other teeth in the dental arch by being firmly anchored in the bony process of the jaw serves to support the teeth and is termed “Alveolar Process”.

The bony space in the alveolar process in which the roots of an erupted tooth is found is called the dental “Socket”. On the other hand, the bony space in which the developing unerupted tooth is found is called “Crypt”.

The tooth is attached to the bony alveolus by a strong ligament known as the

"Periodontal Ligament". The soft fibrous tissue which covers the alveolar process and surrounds the necks of the teeth is termed the *"Gingiva"* of the *"Gum"*.

Structural Elements of the Tooth

The four tissues that constitute the tooth are the *"Enamel"*, *"Dentin"*, *"Cementum"* and *"Pulp"*. The first three tissues are hard mineralized tissues composed of organic matrix embedded by crystalline forms of calcium phosphate salt. The pulp is soft connective tissue. (Fig. 6)

Enamel

The enamel covers the outer surface of the crown. It is thickest over the tip of the crown and becomes thinner until it ends at the cervical line. Enamel is the most mineralized and hardest tissue in the human body. This dense mineralization gives the enamel the ability to resist the wear that the crown of the tooth is subjected to. The enamel is very smooth, a characteristic that gives the crown a self-cleaning ability.

Cementum

It is a bony like substance that covers the root of the tooth. Its main function is to provide a medium for the attachment of the tooth to the alveolar bone. Cementum is less dense and less hard than enamel and dentin, but denser and harder than bone. The cementum is quite thin at the cervical line but increase slightly in thickness at the apex of the roots.

Dentin

Dentin forms the main bulk of the body of the tooth. It is wrapped in an envelop of enamel, which covers the crown, an an envelop of cementum, which covers the root. Dentin is a hard dense calcified tissue that is softer than enamel but harder than cementum and bone. The junction of enamel and dentin is called *"Dentino-Enamel Junction"* and the junction between cementum and dentin is called *"Dentino-Cemental Junction"*.

Pulp

The pulp is the nourishing, sensory and dentin reparative system of the tooth. It is made up of connective tissue, blood vessels, lymphatic and nerves. The pulp tissues is housed in the pulp cavity in the center of the tooth, that is surrounded by dentin.

- Anatomically the pulp cavity consists of two parts, the *"Pulp Chamber"* housed within the crown por-

tion and the *"Pulp Canal"* which is located within the root portion of the tooth.

- The constricted opening of the pulp canal is called the *"Apical Foramen"* and it is possible for a pulp canal to have two or more branches which make their exist at or near the apex of the root, these are called *"Multiple Foramina"* or *"Supplementary Canals"*. However many roots may have more than one canal that end in a common foramen.
- The shape of the pulp canal or canals follows that of the respective root. It tapers from the apex to the final constriction at the apical foramen
- The *"Pulp Chamber"* is always a single cavity and is centered in the crown, with an outline that roughly conforms with that of the crown. There are prolongations in the roof of the pulp chamber that correspond to various cusps of the crown of posterior teeth and the developmental lobes of the anterior teeth of young persons, these are called *"Pulp Horns"* and it disappear by age.■

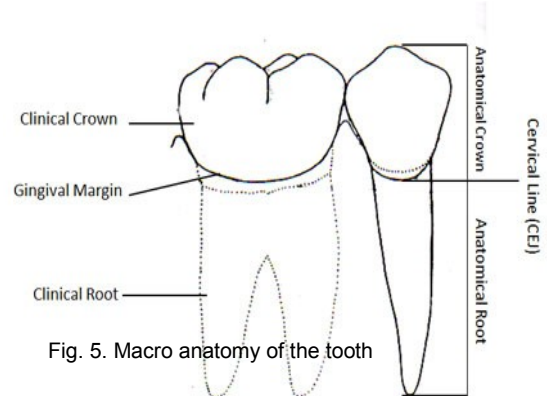


Fig. 5. Macro anatomy of the tooth

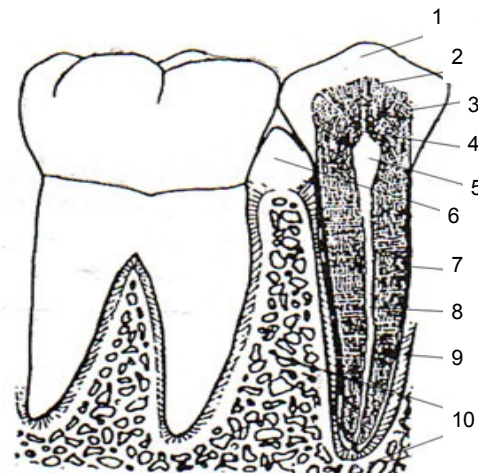


Fig. 6. Structure elements of teeth and their supporting structures

1. Enamel, 2. Dentino-enamel junction, 3. Dentin, 4. Pulp horn, 5. Pulp chamber, 6. Gingiva, 7. Cementum, 8. Pulp canal, 9. Periodontal ligament, 10. Alveolar bone

Surface Characteristics of Teeth

The crown of the tooth is divided into surfaces which are named according to the direction in which they face. The anterior teeth, incisors and canines, have four surfaces and a ridge, while the posterior teeth, premolars and molars, have five surfaces. The surfaces are named as follow:

- Facial or Labial / Buccal Surface:** this is the outer surface of the anterior teeth, which is facing the face or the lip. The term *"labial surface"* is more commonly used. The outer surface of the posterior teeth, premolars and molars, is termed the *"buccal surface"*.
- Palatal / Lingual Surface:** it is the inner surface of all teeth, anterior and posterior. That of the maxillary tooth is termed *"palatal surface"* because it face the palate, while the inner surface of the mandibular teeth is termed *"lingual surface"* because it faces the tongue.
- Mesial and Distal Surfaces:** The surface of the tooth that faces the midline is termed *"mesial surface"* while that faces away from the midline toward the back of the mouth is termed *"distal surface"*. The term *"Proximal Surface"* denotes any surface between two adjacent teeth, it could be mesial or distal. The area of the mesial and/or the distal surface which touches its neighbor in the arch is termed the *"Contact Area"*.

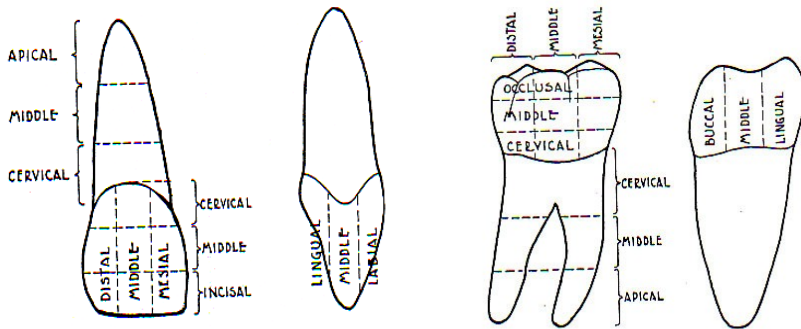


Fig. 7. Divisions of tooth surfaces. Vertical divisions into thirds (upper) and buccal and proximal horizontal divisions (lower)

- **Incisal Edge or Ridge and Occlusal Surface:** The cutting edge of the anterior teeth that is used for mastication is termed the “*incisal edge or ridge*”, while in the posterior teeth it is termed the “*occlusal surface*”.

Division of Tooth Surfaces

For purpose of facilitating localization of various areas within a specific surface of the tooth, the surface is divided into thirds in horizontal direction, as well as, in mesiodistal and bucco-lingual /palatal directions. (Fig. 7)

Line Angles and Point Angles

“*Line angles*” are imaginary lines formed by the junction of two surfaces. The line where surface A met surface B is called AB line angle. If A is the labial surface and B is the mesial surface of an anterior tooth, accordingly the line that is formed by the meeting of them is termed “*Mesio-Labial Line Angle*”.

“*Point Angle*”, on the other hand, is the point where three surfaces met. The point where the labial and mesial surface join with the incisal ridge of an anterior tooth is termed “*Mesio-Labio-Incisal Point Angle*”. (Fig. 8)

Crown Elevations

- **Cusps:** This are conical or pyramidal projections on the crown portion of the tooth that makes up a major division of its occlusal surface. Cusps are found in premolars, molars and canines and each cusp represent a calcified developmental lobe. (Figs 9 and 10)
- **Tubercle:** It is a small elevation on some portion of the crown which is produced by extra formation of enamel. It is mostly present in the second deciduous molar and the first permanent molars.
- **Cingulum:** It is a convex bulk of the cervical third of the lingual surface of the anterior teeth that

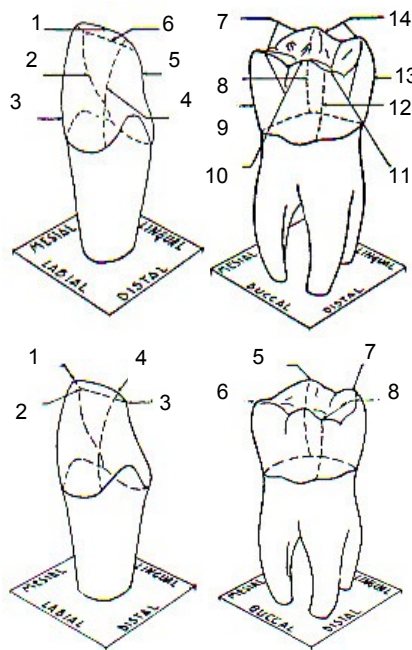


Fig. 8. Line angles (upper) and point angles (lower) .

Line Angles

Labioincisal, 2. Mesiolingual, 3. Mesiolabial, 4. Lingoincisor, 5. Distolingual, 6. Distolabia, 7. Mesio-occlusal, 8. Mesilingual, 9. Mesio Bucca, 10. Bucco-occlusal, 11. Linguo-occlusal, 12. Distolingual, 13. Distobuccal, 14. Disto-occlusal

Point Angles

1. Mesiolabioincisal, 2. mesiolinguoincisor, 3. distolabioincisal, 4. distolinguoincisor, 5. mesiolinguoocclusal, 6. Mesio Buccoocclusal, 7. Distolinguoocclusal, 8. distobuccoocclusal

represent the lingual developmental lobe.

- **Ridges:** This are linear elevations on the surfaces of the crown and are named according to their location and/or shape. Several types can be identified as follows:

1. **Marginal Ridge:** Is the linear elevation which is found on the mesial and distal boundaries of the lingual surface of the anterior teeth and the mesial and

distal boundaries of the occlusal surface of the posterior teeth.

2. **Triangular Ridge:** Is a linear ridge which descends from the tip of the cusp toward the central area of the occlusal surface of the posterior teeth.
3. **Transverse Ridge:** Is the union of two triangular ridges which transversely cross the occlusal surface of posterior teeth usually the lower first premolar.
4. **Oblique Ridge:** It is the union between two triangular ridges of two cusps, not facing each others and crossing the occlusal surface of the maxillary molars. It extends obliquely from mesiolingual cusp to distobuccal cusp.

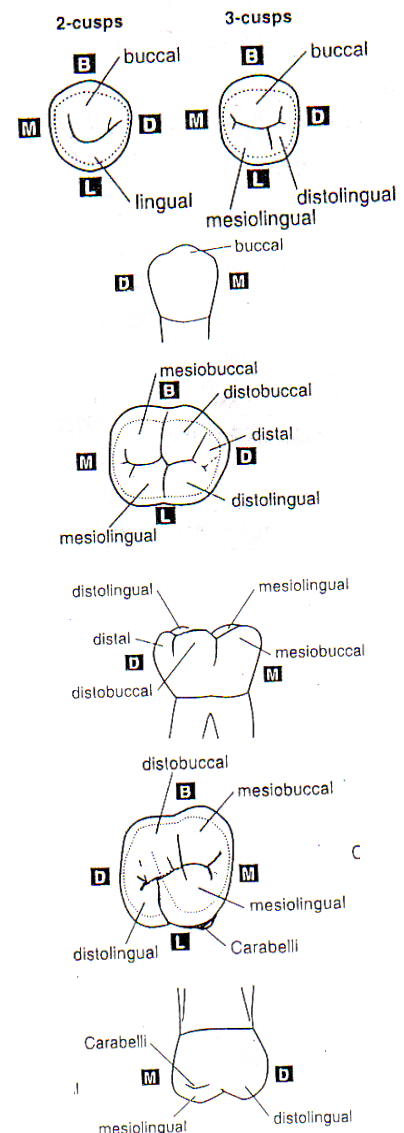


Fig. 9. Examples of major cusps of lower second premolar (upper), Lower first molar (middle) and upper first molar (lower)

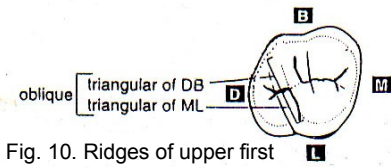


Fig. 10. Ridges of upper first permanent molar.

Other ridges are named according to their site and present as elevations are “incisal, labial, lingual, buccal and cervical ridges”.

Crown Depressions

- **Fossa:** This is an irregular depression or concavity and is named according to its shape and location.

1. **Central Fossa:** present on the occlusal surface of molars and formed by the converging of ridges and cusps that terminate at the center as a depression.
2. **Lingual Fossa:** Is a depression formed on the lingual surface of the anterior teeth.

3. **Mesial or Distal triangular Fossa:** Found on the occlusal surfaces of premolars and molars, mesial or distal to the triangular ridges.

- **Sulcus:** It is a long depression or valley between ridges and cusps, the inclines of which meets at an angle. A Sulcus has a developmental groove at the junction of its inclines.
- **Developmental Grooves:** It is a groove or line in the bottom of the Sulcus which denotes union of the primary parts or lobes of the crown of the tooth. (Figs 11 and 12)
- **Supplemental Grooves:** These are grooves which branch from the developmental grooves, they do not indicate union between primary lobes.
- **Pits:** These are small pinpoint depression located at the junction of developmental grooves and/or at their terminals.

Other Terms

- **Inclined Planes:** These are slopes from cusp tips to the developmental grooves.
- **Height of Contour:** This is the point of maximum convexity of tooth surface.
- **Developmental Lobe:** Is the first site of calcium deposition. Each tooth begins its development from four or more growth centers which are known as “Developmental Lobes”:

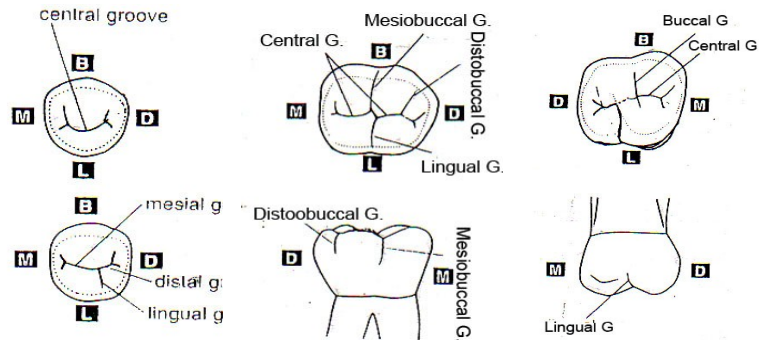


Fig. 11. Developmental grooves of lower 5 (upper), lower first molar (middle) and upper first molar (lower).

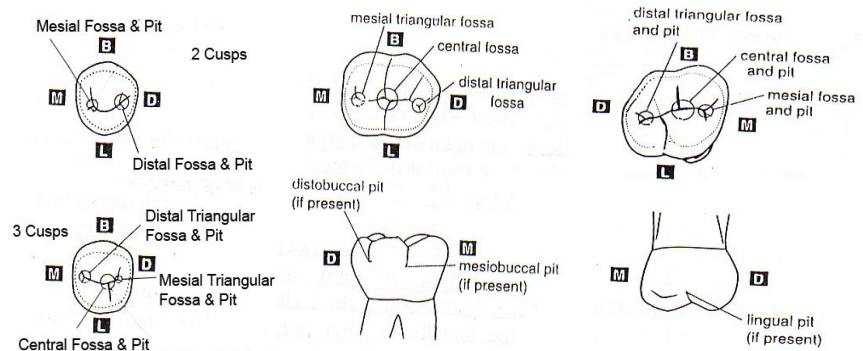
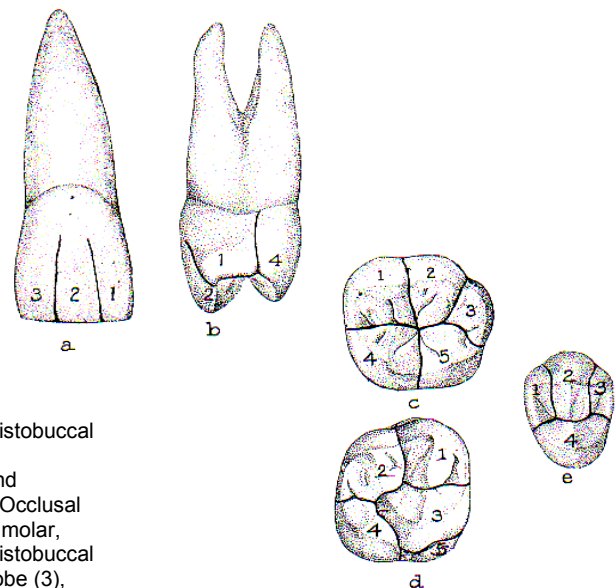


Fig. 12. Fossae and pits of lower second premolar (upper), lower first molar (middle) and upper first molar (lower).

Fig. 13. General outline of some of the lobes. a: Labial aspect of maxillary central incisor, mesial lobe (1), labial lobe (2) and distal lobe (3), b and e: Mesial and occlusal aspect of maxillary first premolar, mesial lobe (1), buccal lobe (2), distal lobe (3) and lingual lobe (4), c: Occlusal aspect of mandibular first molar, mesiobuccal lobe (1), distobuccal lobe (2), distal lobe (3), mesiolingual lobe (4) and distolingual lobe (5), d: Occlusal aspect of maxillary first molar, mesiobuccal lobe (1), distobuccal lobe (2), mesiolingual lobe (3), distolingual lobe (4) and fifth lobe (fifth cusp) (5)



- The anterior teeth, the maxillary premolars and the mandibular first premolar develop from four developmental lobes, three labial and one lingual.
- The mandibular second premolar may be two-cuspid, and show the same number and arrangement of the developmental lobes as the mandibular first premolar, or three-cuspid and, therefore, have five lobes three labial and two lingual.
- All molar teeth have two buccal and two lingual lobes, except the mandibular first molar which may have a fifth buccal lobe.
- The lobes grow until they fuse, and the line of fusion is marked by a line that is termed the “Developmental Groove”, that can be seen on the tooth after its eruption but soon disappear due to wear and attrition.
- The developmental lobes are represented by cusp, cingulum and mamelon. ■

Development, Calcification & Eruption of Teeth

Development of Teeth

During the six week of fetal life tiny teeth germs begin to grow within the alveolar process of the fetus. "Tooth Germs" are small clumps of cells that have the ability to form dental (tooth) tissues i.e. enamel, dentin, cementum and pulp. (Fig. 14)

- From the deepest layer of oral epithelium a band called the "Dental Lamina" extends deep inside the jaw all around.
- From the dental lamina epithelium bud out and named the "Dental Organ", which is the first sign of tooth development.
- The mesodermal tissue around each dental organ become influenced by its growing cells forming localized area of mesoderm called the "Dental Papillae", which is seen in the concavity of the dental organ.
- A mesoderm tissue also encircle each dental organ and dental papilla forming the "Dental Sac".
- The dental organ, dental papilla and dental sac are called the "Tooth Germ".
- Cells forming the "Enamel" are differentiated from the "Dental Organ".
- The cells forming "Dentin and Pulp" are differentiated from the "Dental Papilla".
- Cells that form "Cementum, Periodontal Ligament and Alveolar Bone" are derived from the "Tooth Sac".

The dental lamina of each jaw gives off ten dental organs of deciduous teeth. Lingual to the deciduous dental organs, "Successional Laminae" are extended to form the permanent successors. These teeth are the permanent incisors, canines and premolars. The development of the dental organ begins at the fifth month intrauterine for the permanent central incisors and ends at about the age of ten months for the second premolar. The tooth germs for the developing permanent incisors and canines are in a position lingual to the deciduous roots, while that for the premolar are within the bifurcation of the deciduous molar roots.

Calcification

hard dental tissues, enamel, dentin and cementum, first lays down a soft organic matrix. This is followed by deposition of mineral salts, mostly calcium, circulating in the blood, into this matrix in the form of globules called "Calcospherites". The calcospherites enlarge and fuse together forming the calcified dental tissues. This calcification process continue till about the fourth year of life for the deciduous teeth and for the permanent dentition until the twenty-fifth year of life.

Eruption

The development of the crown and root takes place within a bony "Crypt" in the jaw bone. After the formation of the crown and about 1/3 of the root, the tooth starts to erupt and penetrate the oral mucous membrane. The tooth continue to erupt and as it reaches the occlusal plane 2/3 of it root becomes formed. When the tooth is newly erupted, the dental pulp is large and then becomes progressively smaller.

Formation of the tooth is said to be completed when the apex of the root is formed. This occur between 1-11/2 years

Each cell is specialized to form one of the

after the emergence of the tooth in the mouth for the deciduous teeth and between 2-3 years for the permanent teeth.

After the tooth reach the occlusal plane it continue to erupt and more of the crown become exposed as the tooth moves occlusally. Formation of the root dentin and cementum continue after the tooth is completely formed.

As for the chronology of eruption of teeth the following rules is to be considered:

- Eruption of mandibular teeth usually precede that of maxillary teeth.
- Teeth in both jaws erupt in pairs, one on the right and one on the left.
- Teeth erupts slightly earlier in girls than in boys.

Deciduous Dentition

At the age of 6 months, the deciduous mandibular central incisors show up in the mouth. The usual sequence of eruption of deciduous dentition are: Central Incisors, 6 months lower and 7 months upper, lateral incisors, 7 months lower

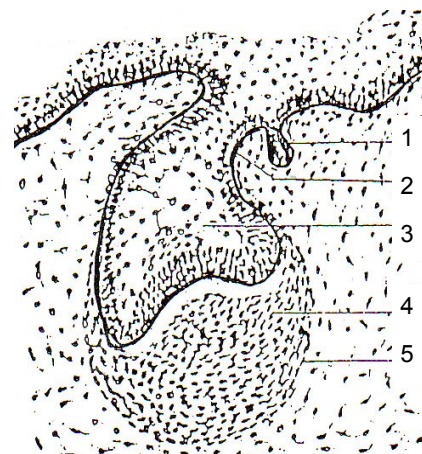
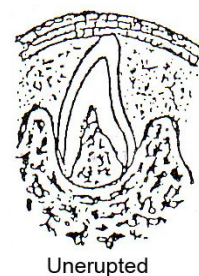
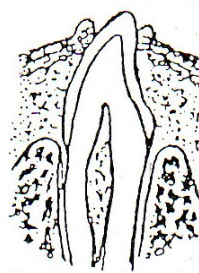


Fig. 14. Early stage of tooth development.

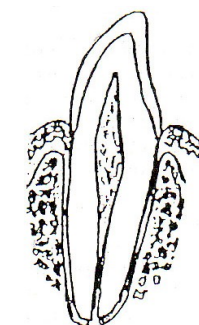
1. permanent tooth bud,
2. Dental lamina,
3. Enamel organ,
4. Dental papilla,
5. Dental sac



Unerupted



Beginning of Eruption



Eruption Completed

Fig. 15. Eruption of teeth.

and 8 months upper, first molar, 12 months lower and 14 months upper, canines, 16 months lower and 18 months upper, second molar, 20 months lower and 24 months upper.

Although deciduous teeth are temporary yet they are important for the following reasons:

- Normal function on both sides of the dental arches is important for normal jaw development.
- To guide the first permanent molars into their normal position.
- Deciduous teeth contribute to the health and wellbeing of the individual during an important period of growth between 6-12 years.

Permanent Dentition

The permanent tooth in its follicle attempt to force its way into the position held by its predecessor. The pressure brought to bear against the deciduous root result in its resorption. Root resorption of deciduous teeth will continue until the crown loses its anchorage, becomes loose and finally exfoliated. The first tooth of the permanent dentition to erupt and emerge in oral cavity is the first mandibular molar. The first permanent molars are called the “Six Years Molars” because they erupt at the age of

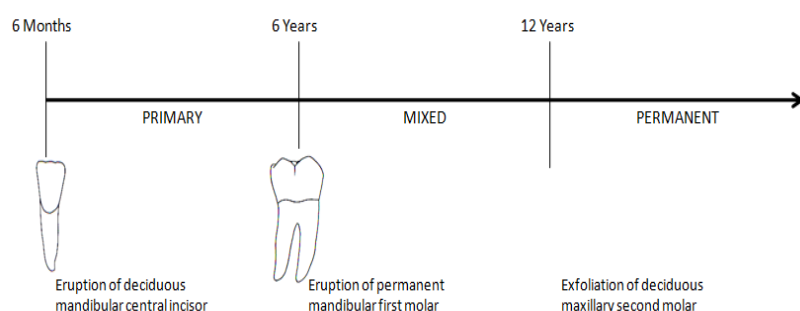


Fig. 16. diagrammatic representation for the dentition stages.

Table II. Permanent dentition chronology

Tooth	E.O App.	S. Cal.	Cr. Comp.	Eruption	Root Comp.
1	U 5 MIU	3-4 M	4-5 Y	7-8 Y	10 Y
	L 5 MIU			6-7 Y	9 Y
2	U 5 MIU	10-12 M	4-5 Y	8-9 Y	11 Y
	L 5 MIU	3-4 M		7-8 Y	10 Y
3	U 6 MIU	4-5 M	6-7 Y	11-12 Y	14-15 Y
	L 6 MIU			9-10 Y	12-14 Y
4	U 7 MIU	18-21 M	5-6 Y	10-11 Y	12-13 Y
	L 7 MIU	21-24 M		10-12 Y	
5	U 8 MIU	24-27 M	6-7 Y	10-12 Y	13-15
	L 8 MIU	27-30 M		11-12 Y	
6	U 4 MIU	At Birth	3-4 Y	6-7 Y	9-10 Y
	L 4 MIU		2.5-3 Y		
7	U 1Y	2.5-3 Y	7-8 Y	12-13 Y	14-16
	L 1Y	2.5-3 Y			
8	U 4Y	7-9 Y	12-16 Y	17-21 Y	18-25
	L 4Y	8-10 Y			

E.O.App, Enamel organ appearance -
S.Cal., Start calcification -
Cr.Comp., Crown completed -
MIU, Month interuterine - Y, Year

6 years, just distal to the second deciduous molar. The chronology of the permanent dentition is shown in table II.■

DESCRIPTION OF PERMANENT TEETH

To describe a tooth it advisable to start with the chronology of the tooth followed by its type and function, number of lobes, relation of the tooth, number of surfaces and roots, geometric outline and anatomy of each surface, root curvatures and anatomy

The Incisors

General Features

- There are eight permanent incisors, four maxillary (upper) and four mandibular (lower). The maxillary consist of two centrals and two laterals, as do the mandibular.
- When viewed from the labial or the lingual aspect the crown of all incisors is trapezoidal in shape. The longer parallel side of the trapezoid is at the incisal edge and the shorter side is close to the cemento-enamel junction. When viewed from the proximal side the crown is triangular in shape with the base represented by the cervical portion.
- The labial and lingual crest of curvatures are at the cervical third of the crown.
- Another common feature of all newly erupted incisors is the presence of rounded portions on the incisal ridge called “Mamelons”. Each mamelon forms the incisal ridge of one of the labial primary lobes (each incisor has four primary lobes, three labial and one lingual). After normal use the mamelons wear down into a flat ridge, therefore the term “Incisal Edge” is more appropriate than ridge.
- The main function of incisors is to incise and cut food material during the process of mastication.

Maxillary Incisors

Maxillary Central Incisor

This tooth has the functions of incising food material as well as esthetic. It has four lobes, three mamelons and a cingulum. The two central incisors make contact mesially with each other and distally with the mesial surface of the lateral incisor. It has four surfaces, labial, palatal, mesial and distal, and incisal aspect. Chronology of the upper central incisor is listed in table I.

Labial Aspect

The maxillary central incisor is the most widest anterior tooth. The geometric outline of the crown is trapezoid. The mesial outline of the crown is straight or slightly convex with the crest of the curvature at the contact area approaching the mesioincisal angle. The mesioincisal angle is relatively sharp.

The distal outline of the crown is more convex than the mesial outline with the crest of curvature being higher toward the cervical line as the distal contact area approaching the middle third. The disto-incisal angle is round.

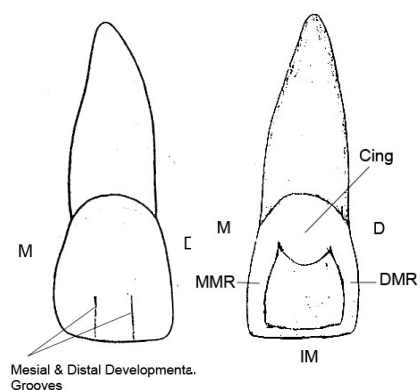


Fig. 17. Surface characteristics of upper right central incisor. Cing, cingulum - DMR, distal marginal ridge - DMR, distal marginal ridge, IM, incisal margin - LF lingual fossa - CA, contact

Table III. Chronology of Upper Central incisor

Dental Organ Appearance	5 MIU
Start Calcification	3-4 M
Enamel Completed	4-5 Y
Eruption	7-8 Y
Root Completed	10 Y

The incisal margin is generally straight and nearly perpendicular to the long axis of the tooth. In newly erupted tooth this margin is characterized by the presence of three mamelons. The cervical line is semicircular with the convexity of the root.

The labial surface is convex in all directions with the highest point of curvature (crest of curvature) located in the cervical third. The convexity tends to decrease to almost a flat surface from the middle one third to the incisal ridge. There are two faint but distinguished shallow grooves extending cervically from the incisal edge and fading out in the middle third. They are termed the mesio-labial and disto-labial developmental grooves and they separate the three mamelons.

The root of the upper central incisor is cone-shaped with blunt apex and regular outline mesially and distally. The root is usually 2-3 mm longer than the crown which is 10-11 mm long.

Lingual Surface

The crown dimension from this aspect is narrower mesio-distally than from the labial aspect since the mesial and distal surfaces converge toward the lingual surface i.e. lingual convergence.

The lingual outline is the reverse of that of the labial aspect. While the labial surface is smooth the lingual surface is irregular. The cervical line is similar to

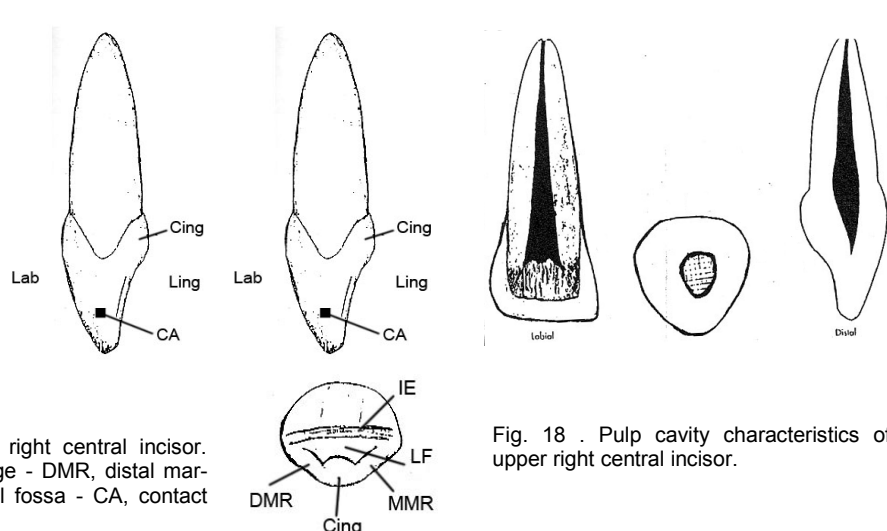


Fig. 18 . Pulp cavity characteristics of upper right central incisor.

that on the labial surface. Immediately below it is a smooth large convexity called the "cingulum", it represents the lingual lobe. The cingulum is located slightly toward the distal surface.

The mesial and distal margins take the form of linear ridges that extend from the incisal line angle to the cingulum. They are referred to as mesial and distal marginal ridges.

The lingual fossa is a shallow smooth concavity below the cingulum that involves the largest part of the middle and incisal part of the lingual surface. It is bordered proximally by the mesial and distal marginal ridges, incisally by the incisal edge and cervically by the cingulum. The lingual fossa may show few irregular lines. In some teeth poorly defined ridges extend from the cingulum to the lingual fossa. The lingual aspect of the root is convex, conical in shape and narrower than the labial aspect.

Mesial Aspect

The mesial surface of the crown is triangular in shape, its base at the cervix and the apex at the incisal ridge. The incisal ridge of the crown is on a line that bisects the center of the root. This alignment is characteristic for maxillary central and lateral incisors.

The labial outline of the crown is convex cervically (the cervical ridge) then it becomes somewhat flattened or slightly curved toward the incisal ridge. The lingual outline, on the other hand, is convex at the cingulum, then becomes concave at the lingual fossa and it becomes slightly convex again at the linguo-incisal ridge. The mesial surface is convex with the maximum convexity at the junction of the incisal and middle thirds (the contact area). The cervical curvature is greater on the mesial surface than any other tooth in the mouth. For the average crown length the curvature is 3-4 mm.

The root from the mesial aspect is cone-shaped with blunt apex.

Distal Aspect

There is a little difference between the distal and mesial surfaces. The curvature of the cervical line is less on the distal surface (about 1 mm less). This is a characteristic for most teeth. The distal surface shows maximum convexity located at the center of the middle third (the contact area).

Incisal Aspect

The crown shows a triangular shape with its apex at the lingual surface and the base placed labially. The incisal ridge can be seen clearly slopping lingually. The labial surface of the crown from this aspect is broad and flat in comparison with the lingual surface, especially toward the incisal third. Labially the cervical portion of the crown is convex (the cervical ridge).

The lingual outline tapers lingually toward the cingulum. The cingulum is shifted distally; accordingly a line drawn from the mesio-incisal angle to center of the cingulum is longer than a line drawn from the disto-incisal angle to the center of the cingulum. A view of the crown from this aspect superimposes it over the root entirely, so that the latter is not visible.

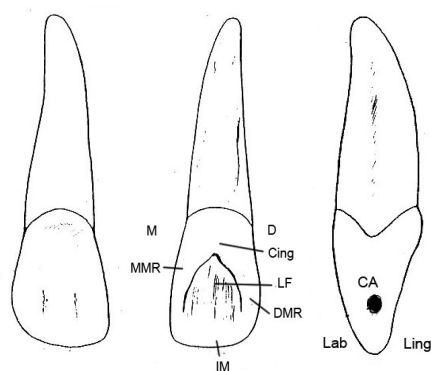


Fig. 19. Surface characteristics of upper right lateral incisor. Cing, cingulum - DMR, distal marginal ridge - MMR, mesial marginal ridge, IM, incisal margin - LF lingual fossa - CA, contact area. (From left-to-right: Labial, Lingual, Mesial, Distal and Incisal surfaces)

The Pulp Cavity

The pulp cavity has pulp chamber and one root canal which varies in size with the age of the tooth. When the tooth first erupts, it is very large and the root is incompletely formed, so the canal looks somewhat funnel shaped in the region of the apical foramen. Later as the tooth develops completely, the pulp becomes smaller and the apical foramen is then very small. This process is continuous throughout life.

On a Labio-lingual section the pulp chamber point incisally then follows the increase in the crown dimension cervically. Starting from the cervical level of the crown the root canal tapers gradually as it traverses the root to end in a constriction at the apex which is termed "the apical foramen"

On a mesio-distal section the pulp chamber is wider from this view, confirming the shape of the crown. It tapers from the incisal part, but is further wide at the cervix. It represents three pulp horns corresponding to the three mamelons. The root canal tapers toward the apex. On cervical cross section the pulp chamber is roughly triangular in young teeth and becomes rounded or crescent shaped in old teeth. It is perfectly centered.

Maxillary Lateral Incisor

The maxillary lateral incisors complement the central incisor in function. It is smaller in all dimensions than the central except for the root length. The crown is about 2 mm narrower mesio-distally and 2 mm shorter and 1 mm less labio-lingually than the central incisor. Chronology of the upper central incisor is listed in table I.

The lateral incisor may show malformation more than any other tooth in the

Table VI. Chronology of Upper Lateral Incisor

Dental Organ Appearance	5 MIU
Start Calcification	1 Y
Enamel Completed	4-5 Y
Eruption	8-9 Y
Root Completed	11 Y

mouth except the third molar. It may show a large pointed tubercle as a part of the cingulum, or deep developmental grooves which extends which extends down with on the root lingually with deep fold in the cingulum. Other laterals may show twisted roots of distorted crowns. Not uncommon situation is to find maxillary lateral incisors that have pointed form. Such teeth are called "peg-shaped" lateral incisor. In some individuals the lateral incisors are missing.

Labial Aspect

The labial surface of the crown is more convex than that of the central incisor. It shows rounded incisal ridge and rounded incisal angles both mesially and distally. Like the central incisor, labial developmental grooves are present.

The mesial outline of the crown resembles that of the central incisor, but usually shows more curvature with the crest of curvature at the contact areas at the junction of the middle and incisal thirds. The distal outline is more convex and the crest of curvature is more cervically, usually at the center of the middle third. The disto-incisal angle is more rounded than the mesio-incisal angle. The incisal outline is more curved than that of the central because of the more rounded incisal angles. The cervical line curves apically with about the same depth of curvature as the case with the central incisor.

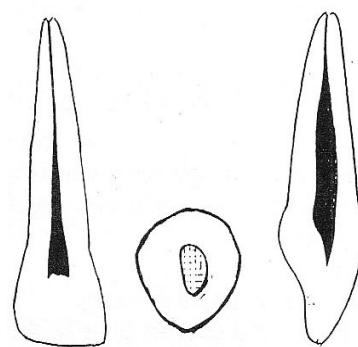


Fig. 20. Pulp cavity characteristics of upper right lateral incisor.

The root is about one and half the length of the crown. It tapers evenly from the cervical line to a point approximately two thirds of its length then it usually curves sharply in a distal direction and end in a pointed apex.

Lingual Aspect

The outline is the reverse of the labial aspect. Mesial and distal marginal ridges and cingulum is usually prominent, with tendency toward deep developmental grooves within the lingual fossa, where as it joins the cingulum. It is common to find a deep developmental groove at the distal side of the cingulum, which extends up to the root for part or all of its length. The lingual fossa is more concave than that of the central.

Mesial Aspect

The crown outline is triangular. It is similar to, but smaller than, that of the central incisor. The root appears longer and the labio-lingual measurement of the crown and the root is about one millimeter less than that of the central. The contact area is located near the junction of the incisal and middle thirds. It is slightly wider, larger and closer to the incisal edge than the distal contact area. The cervical line is less curved than that of the central incisor.

A line drawn through the central of the root tends to bisect the incisal ridge of the crown. The root is conical in shape and shows shallow depression.

Distal Aspect

The distal surface is smaller, but more convex in all dimensions than the mesial surface. The distal marginal ridge is irregular. The contact area is narrower and more cervically placed than the mesial one. The cervical line shows less curvature than the mesial surface.

Incisal Aspects

It usually resembles that of the central incisor, but rarely it may resemble that of

a small canine. The cingulum and incisal edge or ridge may be large. The labio-lingual dimension may be greater than usual in comparison with that of the central incisor, resembling that of a canine. All maxillary lateral incisors show more convexity labially and lingually from the incisal aspect than the maxillary central incisors and the cingulum is centered.

Pulp Cavity

It consists of pulp chamber and a root canal. The chamber is quite similar to that of the central incisor, but without the three sharp pulp horns. More often the pulp chamber ends incisally as one round horn or two less sharp pulp horns, a mesial and distal.

Mandibular Incisors

The mandibular incisors are four in number and have smaller mesio-distal dimensions than any other tooth. The contact areas are near the incisal edge both distally and mesially. The labial surfaces are inclined lingually so that the incisal ridges are lingual to a line bisecting the root.

Mandibular Central Incisors

The mandibular central incisor is the smallest in the dental arch. The crown has little more than half of the mesio-distal dimension of the maxillary central incisor; however, the labio-lingual diameter is only about one millimeter less than that of the maxillary central incisor. The crown is shorter than that of the maxillary central by about 1.5 mm.

Labial Aspect

It is trapezoidal in outline with smallest side at the cervix. The mesial and distal outline of the crown make a straight drop downward from the incisal angles to the contact areas which are close to the incisal edge. The mesial and distal sides then taper evenly from the contact area to the narrow cervix. The mesio-incisal and disto-incisal angles are sharp. The incisal margin is straight and at right angle to the long axis of the tooth.

The labial surface is convex both mesio-distally and inciso-cervically with definite convexity in the cervical one third where the height of contour is located (cervical ridge) and a flattened surface at the incisal third. Mesio-labially and disto-labially developmental grooves are very

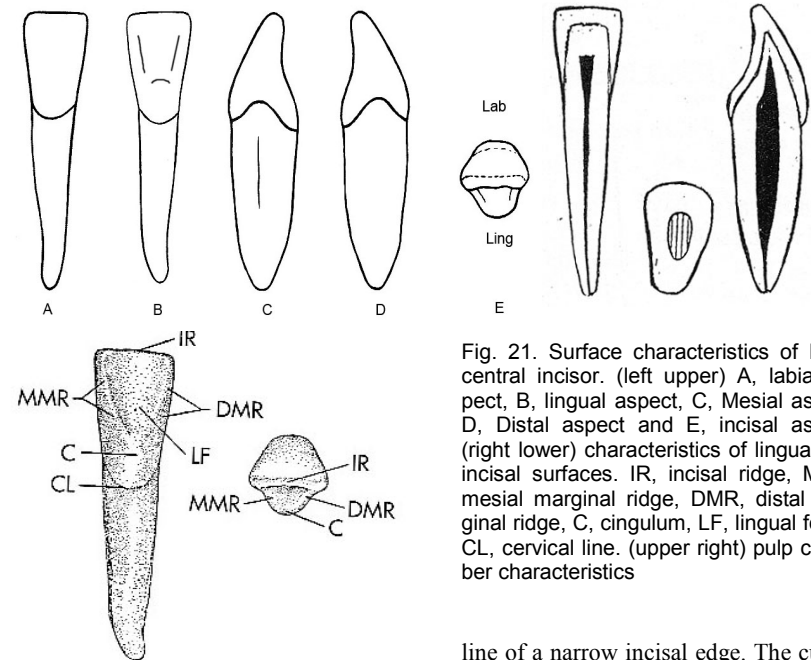


Fig. 21. Surface characteristics of lower central incisor. (left upper) A, labial aspect, B, lingual aspect, C, Mesial aspect, D, Distal aspect and E, incisal aspect. (right lower) characteristics of lingual and incisal surfaces. IR, incisal ridge, MMR, mesial marginal ridge, DMR, distal marginal ridge, C, cingulum, LF, lingual fossa, CL, cervical line. (upper right) pulp chamber characteristics

Table V. Chronology of mandibular central incisor

Dental Organ	Appearance	5 MIU
Start Calcification		3-4 M
Enamel Completed		4-5 Y
Eruption		6-7 Y
Root Completed		9 Y

faint if present. The cervical line is symmetrically curved toward the root with distal diviation.

The mesial and distal root outlines are straight and are continuous with the mesial and distal outlines of the crown. They slop down to the apical portion and terminate in small pointed taper in most cases curving distally.

Lingual Aspect

The outline of the crown is the reverse of the labial surface, and is narrower. It presents a cingulum much smaller than that of the maxillary anteriors. The lingual fossa is shallow and the mesial and distal marginal ridges are less prominent. The cingulum is placed more cervically and is centered. It is smooth with no accessory ridges, grooves or pits. The root is slightly narrower than labially.

Mesial Aspect

Labial outline of the crown is straight above the cervical curvature, sloping rapidly from the crest of curvature to the incisal edge. The **lingual outline** shows smooth convexity at the cingulum then it becomes straight line inclined labially for a short distance to join a concave line at the middle third of the crown. This extends upward to join the rounded out-

line of a narrow incisal edge. The curvatures above the **cervical line** labially and lingually are less than the maxillary incisor.

The **incisal margin** is straight of slightly rounded, and its center is located just lingual to the center of the root. The contact area is very close to the incisal edge. The cervical line shows a marked curvature incisally about one third the length of the crown.

The root outlines labially and lingually are straight with the crown outline from the cervical line. The root starts to taper in the middle third to either a bluntly rounded or pointed root end. The mesial surface of the root is flat just below the cervical line. Most of these roots have a broad developmental depression for the most of the root length which is deeper at the junction of the middle and apical thirds. In rare cases the root apex is bifid.

Distal Aspect

It is the reverse of the mesial aspect. The cervical line curves incisally about 1 mm less than on the mesial. The developmental depression is more marked with well defined developmental groove at its center.

Incisal Aspect

From this view, the tooth is four sided or diamond shaped. The incisal edge is straight and the mesial and distal halves are identical. The cingulum is slightly shifted towards the distal portion. The crown appears centered over the root. The incisal ridge is perpendicular to a line bisecting the crown labiolingually.

Pulp Cavity

In labio-lingual section the outline of the

pulp cavity conform to the crown and root outline. The mesiodistal section is narrow and has two pulp horns directed to the mesial and distal angles of the incisal edge. Crow section of the root at the cervical line shows an oval canal usually constricted mesiodistally and wide labiolingually.

Mandibular Lateral Incisor

The mandibular lateral incisor has almost the same form as the mandibular central incisor, however, some variations exist. Table IV list the chronological data of mandibular lateral incisor.

Labial aspect

The tooth resembles the central incisor except that it is slightly larger by 0.5 mm in all directions and is fan shaped. The mesial side is often longer than the distal side, causing distal sloping of the incisal edge. The distoincisor angle is more rounded than its counterpart in the mandibular central.

The distal contact area is more toward the cervical line than the mesial contact area to contact properly with the canine. The crown is larger than that of the central and the root is longer by about 1.5 mm.

Lingual Aspect

Similar to that of the central incisor but the mesial outline and the mesial marginal ridge are longer than the distal.

The cingulum is deviated distal to the center of the lingual surface.

Proximal Aspects (Mesial and Distal)

Differ from the center counterpart in the following:

- The distal surface of the lateral incisor is shorter than the mesial surface.
- Both cervical line curvatures are slightly less than that of the central incisor.
- The distal contact area is more cervically located than the mesial one.
- Root depressions are seen on both the mesial and distal surfaces.

Incisal Aspect

The mandibular lateral incisor appears to be rotated over their root axes because the distal developmental lobe is larger and more mesially located than the distal lobe. This is because the tooth has to

Table VI. Chronology of Mandibular lateral incisor

Dental Organ Appearance	5 MIU
Start Calcification	3-4 M
Enamel Completed	4-5 Y
Eruption	7-8 Y
Root Completed	10 Y

curve distally to fit into mandibular arch because it has to fit inside the maxillary arch. The incisal edge follows the curvature of the mandibular dental arch. The cingulum is shifted distally and the incisal ridge follows the curvature of the dental arch. ■

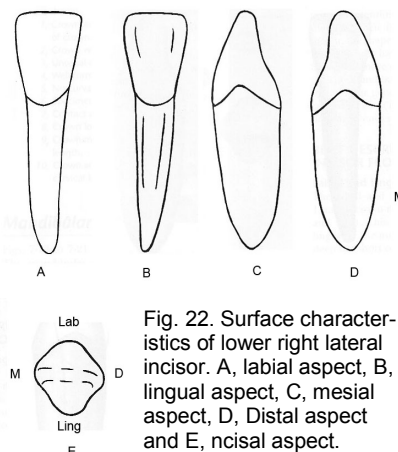


Fig. 22. Surface characteristics of lower right lateral incisor. A, labial aspect, B, lingual aspect, C, mesial aspect, D, Distal aspect and E, ncisal aspect.

The Canines

The canines – two maxillary and two mandibular – bear a close resemblance to each other. They are the longest teeth in the mouth and placed at the corners of the mouth and therefore referred to as the *corner stones* of the mouth.

The canines are well anchored in the bone by their extremely long roots. The crown is bulkier than that of the incisors, and the middle labial lobe is highly developed incisally forming a strong well formed cusp and labial ridge.

The crowns and roots of the canines are markedly convex on most surfaces. When viewed from the proximal aspects they show a triangular shape, however, from labial and lingual aspects they take pentagonal shape.

The position and form of these teeth and their anchorage in the bone, along with a bone ridge over the labial portion of the root, called “canine eminence”, have a osmotic value and ensure facial expression. In function the canines support the incisors and premolars in holding and tearing the food material.

Maxillary Canine

The crown and root of the maxillary canine are narrow mesiodistally than the central incisor. The cervico-incisal length of the crown is much longer than any other anterior tooth, with the exception of the maxillary central incisor. Table V list the chronological data of maxillary canine.

The mesial half of the crown of the maxillary canine resemble a portion of an incisor and contact with lateral incisor. The distal half, on the other hand, resembles a portion of a premolar and contact the first premolar. The incisal portion of the crown is thicker labiolingually then that of the incisors, and the cingulum shows greater development.

Labial aspect

It is pentagonal in outline. The mesial outline is convex from the cervix to the center of the contact area at the junction between the middle and incisal thirds of the crown.

The distal outline between the cervical line and the distal contact area which is situated at the center of the middle third. The mesial contact area is at a lower level than the distal.

The cusp has a mesial and distal slopes. The mesial one is shorter and shows tendency toward concavity, while the distal slope shows tendency toward convexity. The cervical line is convex root wise. Faint mediolabial and distolabial developmental grooves can be seen.

The labial surface is smooth except for a shallow depression mesially and distally dividing the crown into its three labial lobes. The middle lobe is more developed than the other two which result in formation of a ridge on the labial surface, the labial ridge, which runs from the cervical line to the tip of the cusp in a curved manner inclined mesially at its center. The areas mesial to the crest of this ridge exhibits convexity while area distal to it tends toward concavity.

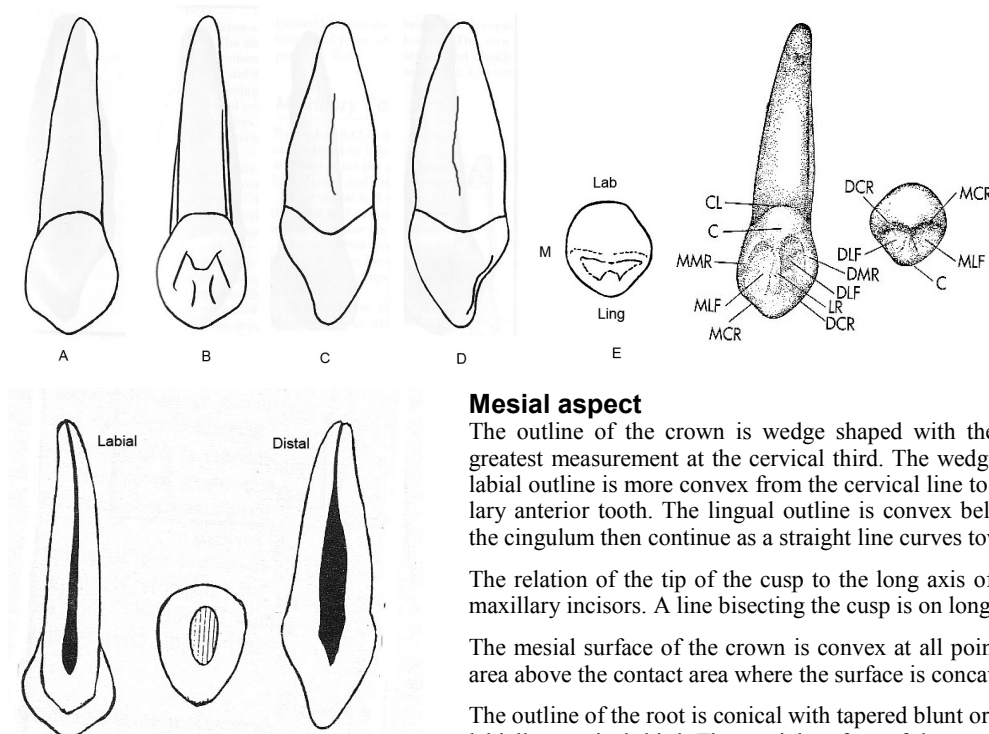


Fig. 23. Surface characteristics of maxillary left canine (left upper) A, labial aspect, B, lingual aspect, C, Mesial aspect, D, Distal aspect and E, incisal aspect. (right upper) characteristics of lingual and incisal surfaces. CL, cervical line, C, cingulum, MMR, mesial marginal ridge, MLF, mesial lingual fossa, MCR, Mesial cusp ridge, DCR, distal cusp ridge, LR, lingual ridge, DLF, distal lingual fossa, DMR, distal marginal ridge, MCR, Mesial cusp ridge.

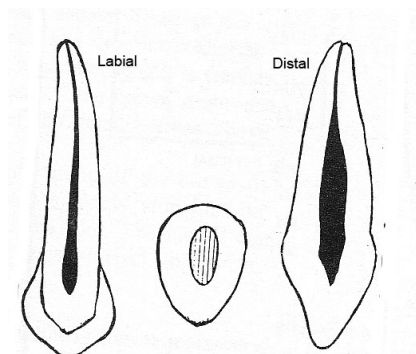


Fig. 24. pulp cavity characteristics of maxillary left canine.

Table VII. Chronology of maxillary canine

Dental Organ Appearance	6 MIU
Start Calcification	4-5 M
Enamel Completed	6-7 Y
Eruption	11-12 Y
Root Completed	14-15 Y

The root appears slender from the labial aspect and is conical with blunt apex. The root may show either mesial or distal curvature, mostly distal, near the apex. The labial surface of the root is smooth and convex.

Lingual aspect

The crown and root are narrower lingually than labially. The cervical line from is less convex than on the labial surface. Below the cervical line is a well developed cingulum. The mesial and distal marginal ridges are strongly developed.

The area incisal to the cingulum is concave forming the lingual fossa. Very often the lingual fossa show a well developed lingual ridge extending from the cusp tip to a point near the cingulum dividing the lingual fossa into mesial and distal.

The root is narrow when viewed from the lingual aspect than the labial and is smooth and convex.

Mesial aspect

The outline of the crown is wedge shaped with the greatest measurement at the cervical third. The wedge point at the tip of the cusp. The labial outline is more convex from the cervical line to the cusp tip than any other maxillary anterior tooth. The lingual outline is convex below the cervical line, representing the cingulum then continue as a straight line curves toward the cusp.

The relation of the tip of the cusp to the long axis of the root is different from that of maxillary incisors. A line bisecting the cusp is on long axis of the tooth or labial to it.

The mesial surface of the crown is convex at all points except for small circumscribed area above the contact area where the surface is concave or flat to the cervical line.

The outline of the root is conical with tapered blunt or pointed apex. The root may curve labially at apical third. The mesial surface of the root appears broad with a shallow developmental depression for part of the root length which helps to anchor the tooth to the alveolus and prevent rotation.

Distal aspect

This aspect is similar to the mesial aspect except that the cervical line shows less curvature toward the cusp tip. The distal marginal ridge is heavier and more irregular than the mesial one and the contact area is more cervically located in the middle third. In addition, the surface is more concave above the contact area and the developmental groove is more pronounced.

Incisal aspect

The labiolingual dimension is greater than the mesiodistal dimension. The cusp tip is labial and mesial to the center of the crown. The ridge of the middle labial lobe is very noticeable from the incisal aspect. It attains its greatest convexity at the cervical third of the crown, becoming broader and flatter at the middle and incisal thirds.

Pulp cavity

It consists of the pulp chamber and a single root canal. Labiolingual section shows a narrow pulp chamber that points incisally. The root canal is wide in the cervical half of the root than any other tooth. The canal then narrows to average width on its way to the apical foramen.

On mesio-distal section the pulp cavity is much narrower and similar to those of the incisors. It has much longer and tapered root canal.

On cervical cross section the pulp cavity appears even narrower and the root canal is elliptical rather than round and centered over the root. The canal is wider labiolingually than mesiodistally.

Mandibular canine

The mandibular canine resembles the maxillary one in that they have the same wedge shaped outline, long crown and a well developed cingulum. They differ from the maxillary canine, however, in some aspects. Table VI lists the chronological data of mandibular canine.

Labial aspect

The crown is narrower mesiodistally by about 0.5 mm than the maxillary one. Labiolingually the crown and root is slightly less than those of the maxillary canine.

On the other hand, the length of the mandibular canine is similar to the maxillary canine, but the crown is longer by 1 mm and the root is shorter by 1 mm. the effect of

Table VIII. Chronology of Mandibular canine.

Dental Organ	Appearance	6 MIU
Start Calcification	4-5 M	
Enamel Completed	6-7 Y	
Eruption	9-10 Y	
Root Completed	12-13 Y	

greater crown length is emphasized by the narrowness of the crown mesiodistally and the height of the contact area above the cervix.

The mesial outline of the crown is nearly straight with the mesial outline of the root. The mesial contact area is near the mesioincisal angle.

The distal outline is convex cervico-incisally with more rounded and obtuse distoincisal angle. It is shorter than the mesial outline and the contact area is located more cervically than the distal one but still more incisalo than the maxillary canine.

The cusp tip and ridges of the mandibular canine are not as well developed as the maxillary canine. The cusp tip is on the center of the root and the distal cusp slope is longer than the mesial one and inclined more cervically.

The cervical line is more symmetrically contoured than the maxillary one.

The crown surface is flat mesial and distal to the labial ridge at the incisal third. Crown outline is concave distally and convex mesially.

The root is shorter by 1-2 mm than the maxillary canine and has a more sharply pointed apex that may be directed mesially of distally.

Lingual aspect

The lingual surface of the crown is flatter, smoother and regular simulating mandibular incisors. The cingulum and the ridges as well as the lingual fossa are less pronounced than in maxillary canine.

The lingual portion of the root is narrower than that of the maxillary canine, it is about one half or a little more in width than the labial portion.

Mesial aspect

The labial outline of the crown is less curved with the crest of the curvature at the cervical third. The lingual outline is also less curved. The cusp tip is centered over the root or slightly lingually inclined (that of the maxillary canine is labially inclined).

The mesial developmental depression on the root is more pronounced and some-

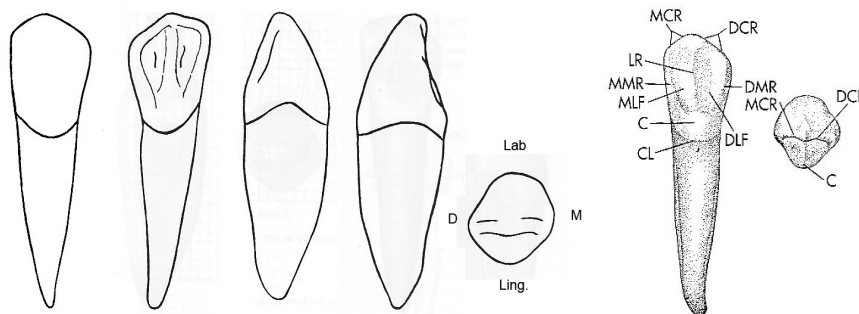


Fig. 25. Surface characteristics of mandibular left canine MCR, mesial cusp ridge, DCR, distal cusp ridge, LR, lingual ridge, MMR, mesial marginal ridge, MLF, mesial lingual fossa, C, cingulum, CL, cervical line, DLF, distal lingual fossa, SMR, distal marginal ridge (From left-to-right: labial, lingual, mesial, distal and incisal surfaces)

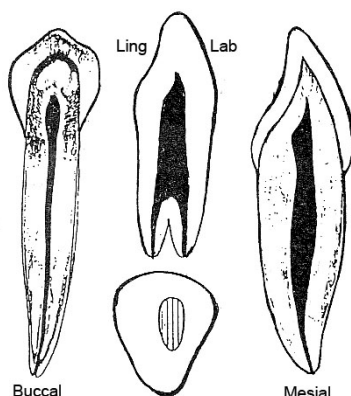


Fig. 26. pulp cavity characteristics of mandibular left canine.

times the root is bifurcated at the apical third.

Distal aspect

There is little difference between distal and mesial aspect which are:

- The distal marginal ridge is more pronounced than the mesial
- The cervical line has less curvature.
- The distal contact area is more cervical.
- More pronounced developmental depression on the root.

Incisal aspect

The outline of the incisal surface is less curved than in the maxillary canine. The cusp tip, mesial cusp ridge and the contact area are inclined lingually, while those of the maxillary canine extends nearly a straight line mesiodistally. The cingulum is shifted distally.

Pulp cavity

Pulp cavity is similar to that of the upper canine but smaller. The root may show one or two root canals - labial and lingual canal - that join at the apex or have separate foramina when the root is bifurcated. There are always two canals.

The Premolars

The premolars are intermediate teeth between molars and canines. They succeed the deciduous molars. The term "bicuspid" is often used in place of premolars, but this is inaccurate since the mandibular second premolar may show three cusps. There are eight premolars, two in each quadrant.

The premolars are developed from four lobes except the mandibular second premolar, the three cusp form, which developed from five lobes, three buccal and two lingual.

The buccal cusp of the first premolar is long and sharp assisting the canine in its function of tearing. The second premolars have cusps less sharp which make them efficient in grinding teeth much like molars.

The marginal ridges of the crown are in a more horizontal plane and are considered part of the occlusal surface of the crown rather than the lingual surface as in case of anterior teeth. The crown and root of the premolars are shorter than those of the canines.

Maxillary Premolars

First Maxillary Premolar

This tooth has two cusps, buccal and lingual, which are sharply defined. The buccal cusp is about 1 mm longer than the lingual cusp and the crown is shorter than that of the canine by 1.5-2 mm. table VII lists the chronological data of the maxillary first premolar.

This tooth is the only premolar which normally has two roots (about 80%), a buccal and a lingual, with two pulp canals, although occasionally there is only one root (20%). It resembles the canine from the buccal aspect but the root is shorter, the mesial slope of the buccal cusp is longer than the distal slope (opposite to the maxillary canine) and the mesiodistal diameter is less than that of the canine. The first premolar presents some characteristics common to all posterior teeth as differentiated from the anterior teeth. (Table VIII)

Buccal aspect

The crown is roughly trapezoid with the smallest uneven side directed cervically. The width of the crown mesiodistally is less at the cervix than at the level of contact areas by 2mm.

The mesial outline of the crown is slightly concave from the cervical line to the mesial contact area and also to the cusp tip. The mesial cusp slope is longer than the distal and the contact area is just cervical to the junction between the occlusal middle one third.

The distal outline is more straight below the cervical line and the contact area is broader and more occlusally placed than the mesial. The cervical line is curved with the crest of the curvature near the center of the root and toward it.

The buccal cusp is long with pointed tip located distal to the midline and divide the occlusal border into a long, straight or concave, mesial cusp ridge and a short convex distal cusp ridge.

The buccal surface of the first maxillary premolar is convex, showing strong development of the middle lobe with a continuous ridge from the cusp tip to the cervical margin. This ridge is called the buccal ridge. Two developmental grooves, mesiobuccal and distobuccal, are located on both sides of the buccal ridge and mark the union of the developmental lobes.

The buccal root outline of the maxillary first premolar is similar to that of the canine but is shorter by 3-4 mm.

Lingual aspect

The crown converges towards the lingual cusp which is shorter and narrower mesiodistally than the buccal one. The tip of the lingual cusp is pointed and located slightly toward the mesial side. The mesial slope is shorter than the distal.

The mesial and distal outlines are convex and continuous with the mesial and distal slopes of the lingual cusp and become more straight as they join the mesial and distal sides of the lingual root.

The crown as seen from the lingual aspect is smooth spheroid and convex at all points with no definite lingual ridge and no developmental grooves. The lingual height of contour is located at the middle third. Since the lingual cusp is shorter than the buccal one, the tips of both cusps can be seen with their mesial and distal slopes from the lingual aspect.

The cervical line is similar to that of the buccal aspect. The lingual aspect of the root, or the lingual aspect of the lingual root if two roots are present, is smooth and convex with blunt apex.

Mesial aspect

It is trapezoidal in shape, however, the longest of the uneven sides is toward the cervical portion and the shortest toward the occlusal portion. Another characteristic of all the maxillary posterior teeth is that the measurement between the tip of the buccal cusp to that of the lingual cusp is less than the buccolingual measurement of the root at its cervical portion, i.e. the tips of the cusps are well within the confines of the root trunk.

The cervical line is curved and regular with average curvature of 1 mm. which is similar to all posterior teeth. The buccal outline of the crown is convex below. The crest of curvature is at the junction of the cervical and middle thirds of the crown. It continues as a line of less convexity to the tip of the buccal cusp. The tip of the buccal cusp is located directly below the center of the buccal root.

The lingual outline is curved smoothly from the tip of the lingual cusp to the cervical line. The crest of the curvature is near the center of the middle third. The tip of the lingual cusp is on a line with the lingual border of the lingual root.

The lingual cusp is always shorter than the buccal cusp by about 1 mm. the mesial marginal ridge is convex and is located at about the level of the junction of the middle and occlusal thirds.

The mesial contact area is circular in shape and located at the junction of the middle and occlusal thirds and slightly near the buccal.

Table XIX. Chronology of maxillary first premolar

Dental Organ Appearance	7MIU
Start Calcification	1.5-1.7 Y
Enamel Completed	5-6 Y
Eruption	10-11 Y
Root Completed	12-13 Y

Table X. Common characteristics of posterior teeth.

- Have occlusal surface instead of incisal ridge.
- Larger bucco-lingual than mesiodistally
- Broader contact area.
- Less curvature of cervical line mesially and distal.
- Shorter crown compared with incisors and canines
- Marginal ridges oriented horizontally and are part of the occlusal surface.

The distinguishing features of this tooth from the mesial aspect are:

- The presence of "*Mesial Developmental Depression*" which extends cervically from the contact area and continues to include the cervical line then joins a deep depression between the root bifurcation, known as "*Canine Fossa*". The maxillary second premolar does not have this feature.
- The presence of a well defined developmental groove in the enamel of the mesial marginal ridge. This marginal groove is continuous with the central groove of the occlusal surface of the crown, crossing the marginal ridge just lingual to the contact area and terminating a short distance cervical to the mesial marginal ridge. This groove is called the "*Mesial Marginal Developmental Groove*".
- The buccal outline of the buccal root is straight above the cervical line with tendency toward lingual inclination. The lingual outline is also straight and may show buccal or lingual inclination. The root trunk is long making up about half the length of the root. The bifurcation of the roots begins at a more occlusal point mesially than distally.
- The mesial surface of the root trunk is smoothly convex buccally and lingually with deep developmental groove and depression at or below the bifurcation. In case of one rooted tooth this depression is noticed for most of the root length.

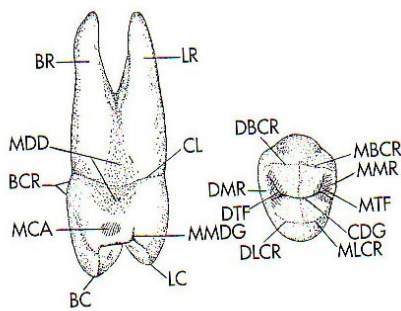


Fig. 27. Maxillary right first premolar, mesial and occlusal aspect. BR, buccal root; MDD, mesial developmental depression; BCR, buccal cervical ridge; MCA, mesial contact area; BC, buccal cusp; LC, lingual cusp; MMDG, mesial marginal developmental groove; CL, cervical line; LR, lingual root; DBCR, distobuccal cusp ridge; DMR, distal marginal ridge; DTF, distal triangular fossa; DLCR, distolingual cusp ridge; MLCR, mesiolingual cusp ridge; CDG, central developmental groove; MTF, mesial triangular fossa; MMR, mesial marginal ridge; MBCR, mesiobuccal cusp ridge.

Distal aspect

The crown outline is similar to the mesial aspect. The crown surface is convex at all points. The distal contact area is wider buccolingually than oclusocervically and slightly near the buccal. It is larger and more cervically located than the mesial contact area.

The height of contour is in the cervical third buccally and middle third lingually. The curvature of the cervical line is less than in the mesial surface. Also there is no evidence of deep developmental groove and the root trunk is flattened above the cervical line. The bifurcation is more toward the apical third with no developmental groove leading to it.

Occlusal aspect

The occlusal aspect has a hexagonal outline. Two equal buccal sides, mesial side shorter than the distal and mesiolingual shorter than distolingual. It is wider buccally than lingually and buccolingually than mesiodistally. The buccal margin is convex with a prominent buccal ridge at the crest of the curvature.

The mesiolingual and distolingual cusp ridges are continuous with the mesial and distal marginal ridges. The crest of the buccal ridge is some what distal to the lingual ridge, while the crest of the distal contact area is somewhat buccal to that of the mesial one.

The occlusal surface shows two well developed cusps, the lingual one is more pointed while the buccal one is larger. Each cusp has four cusp ridges named according to their location, buccal, lingual, distal and mesial ridges. The buccal cusp ridge descends from the cusp tip cervically onto the buccal surface. The lingual cusp ridge of the buccal cusp and buccal cusp ridge of the lingual cusp descends from the cusp tip to the central area of the occlusal surface. The two triangular ridges of the buccal and lingual cusps are separated by the central developmental groove.

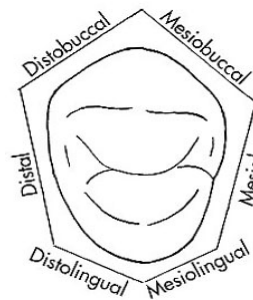


Fig. 28. Occlusal aspect of upper first premolar is hexagonal in outline.

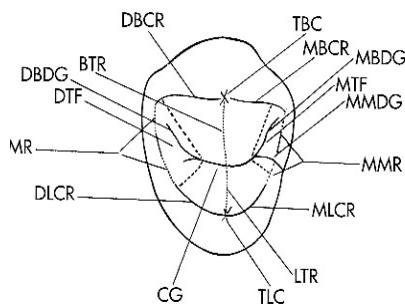


Fig. 28. Maxillary first premolar, occlusal aspect. DBCR, distobuccal cusp ridge; BTR, buccal triangular ridge; DBDG, distobuccal developmental groove; DTF, distal triangular fossa; DMR, distal marginal ridge; DLCR, distolingual cusp ridge; CG, central groove; TLC, tip of lingual cusp; LTR, lingual triangular ridge; MLCR, mesiolingual cusp ridge; MMR, mesial marginal ridge; MMDG, mesial marginal developmental groove; MTF, mesial triangular fossa; MBDG, mesiobuccal developmental groove; MBCR, mesiobuccal cusp ridge; TBC, tip of buccal cusp.

The primary grooves on the occlusal aspect are sharp and deep. A well-defined central developmental groove divides the tooth mesiodistally. It extends from the distal to the mesial marginal ridge where it joins the mesial marginal developmental groove which crosses the mesial marginal ridge and ends on the mesial surface of the crown.

Two developmental grooves join the central groove just inside the mesial and distal triangular fossae. These are called the mesiobuccal and distobuccal devel-

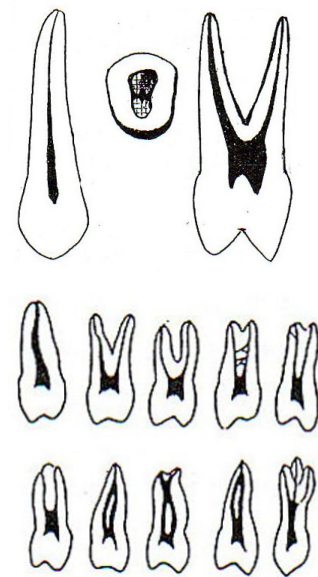


Fig. 29. Pulp cavity characteristics of the upper first premolar. Mesiodistal section (upper left) cross section (upper middle); buccolingual section (upper right); variations of root canals (lower)

opmental grooves. The junction of the grooves are pointed and are named the *mesial and distal developmental pit*. Just inside the mesial and distal marginal ridges are the mesial and distal triangular fossae.

Pulp cavity

In the bucco-lingual section the pulp chamber is broad buccolingually with well developed pulp horns. It presents a funnel-like opening leading to the root canals. The floor of the pulp chamber is below the level of the cement-enamel junction. The lingual root canal is larger than the buccal and both taper evenly toward the apical foramen.

The mesiodistal section is similar to the pulp cavity of the maxillary canine. It is relatively narrow and taper evenly to the apical foramen.

Table XI. Chronology of maxillary second premolar

Dental Organ Appearance	8MIU
Start Calcification	2-2.3 Y
Enamel Completed	6-7 Y
Eruption	10-12Y
Root Completed	13-15 Y

A transverse section at the cementoenamel junction shows the characteristic kidney shaped root trunk and the root is wider buccolingually than mesiodistally.

Maxillary Second Premolar

This tooth supplements the first maxillary premolar in function and very similar to it. The second premolar is single rooted in 85% of cases and has a less angular and rounded crown from all aspect than that of the first premolar. The crown is shorter cervico-occlusally but the root is little longer than that of the first premolar. Table IX list the chronological data of the maxillary second premolar.

Buccal aspect

The buccal cusp is shorter and less pointed than in the first premolar. The mesial slope of the buccal cusp is shorter than the distal slope, which is the opposite for the first premolar.

Lingual aspect

Very similar to the first molar with very little variations.

Mesial aspect

Cusps are shorter than in the first premolar and are almost of the same length. The distance between the cusp tips is wider which widens the occlusal surface buccolingually. Crown is convex with no developmental depression and a shallow developmental groove is seen on the root. No developmental groove crosses the mesial marginal ridge.

Distal aspect

The distal aspect shows very little variations from that of the first premolar.

Occlusal aspect

The occlusal surface outline is more rounded or oval than angular, as the occlusal outline of the first premolar. The distance between the cusp tips is wider, the central developmental groove is shorter and more irregular with multiple supplemental grooves radiating from the central groove. The mesial and distal triangular fossae are nearer to each other.

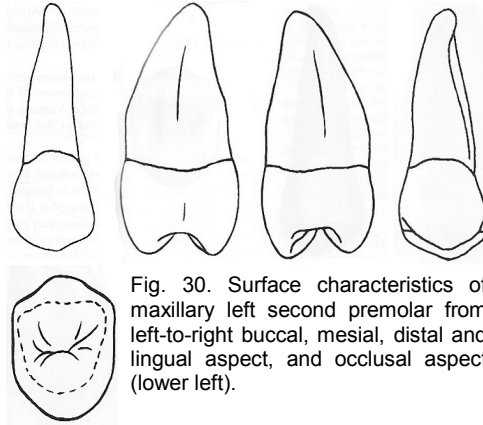


Fig. 30. Surface characteristics of maxillary left second premolar from left-to-right buccal, mesial, distal and lingual aspect, and occlusal aspect (lower left).

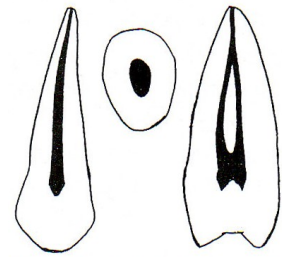


Fig. 31. Pulp cavity characteristics of the upper second premolar. Mesiodistal section (left) cross section (middle); buccolingual section (right).

Pulp cavity

On buccolingual section the pulp chamber is wide with well defined pulp horns. There are two pulp canals, buccal and lingual. The canals are very wide at their junction with the pulp chamber and then narrow until reaches the mid-root where it constricts rapidly to the apical foramen.

The tooth may show single broad pulp canal divided at mid-root into two canals by dentin island then the canals join again near the apical foramen. Mesiodistally the pulp chamber is similar to that of the first premolar. Cervical cross section display an oval root trunk instead of kidney shaped root trunk of the first premolar.

Mandibular Premolars

They are four in number, two in each side of the mandible. As a rule the mandibular first premolars are always smaller than second premolars. The opposite is true for maxillary premolars.

Mandibular First Premolar

The mandibular first premolar has many of the characteristics of a small canine. It has one sharp buccal cusp which is the only part occlude with maxillary teeth. The lingual cusp is small and nonfunctioning resembling a well developed cingulum. (Table X) On the other hand the mandibular second premolar has more of the characteristics of a small molar.

Buccal aspect

The outline is roughly trapezoidal with the smallest of the uneven sides cervically.

The mesial outline of the crown is straight or slightly convex till it joins the curvature of the mesial contact area. The outline of the mesial slope of the buccal cusp usually shows some convexity.

The distal outline of the crown is slightly concave above the cervical line to a point where it is continuous with the curvature of the distal contact area. This curvature is broader than that of the mesial contact area. The distal slope of the buccal cusp shows some concavity.

Table XII. Chronology of mandibular first premolar

Dental Organ Appearance	7MIU
Start Calcification	1.7-2 Y
Enamel Completed	5-6 Y
Eruption	10-11 Y
Root Completed	12-13 Y

Table XIII. Characteristics of first mandibular premolar resembling canine

- The buccal cusp is long and sharp and is the only part occluding
- The mesiodistal and buccolingual measures are similar to the canine
- The occlusal surface slopes sharply lingually in a cervical direction
- The mesiobuccal cusp ridge is shorter than the distobuccal one.
- The outline form of the occlusal aspect resembles the incisal aspect of the canine

Table XIV. Characteristics of first mandibular premolar resembling second premolar

- Crown and root outline from the buccal aspect are similar but the buccal cusp is longer
- Contacts areas are at the same level
- Curvatures of cervical line are similar
- Roots are about the same length

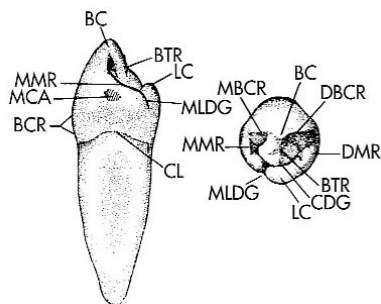


Fig. 32. mandibular right first premolar, mesial and occlusal aspect. BC, buccal cusp, BTR, buccal triangular ridge, LC, lingual cusp; MLDG, mesiobuccal developmental groove; CL, cervical line; BCR, buccal cervical ridge; MCA, mesial contact area; MMR, mesial marginal ridge; MBCR, mesiobuccal cusp ridge; CDG, central developmental groove; DMR, distal marginal ridge.

The tip of the buccal cusp is pointed and is located a little mesial to the center of the crown buccally. The cervical line is curved toward the root.

The buccal surface of the crown is more convex than the maxillary premolars.

The middle buccal lobe of the crown is well developed, resulting in a large pointed buccal cusp with a buccal ridge continuous from the cervical margin to the cusp tip. Mesial and distal to the ridge a developmental depression may be seen separating the three lobes. The mesial cusp ridge is shorter than the distal one.

The contact areas are broad and are almost at the same level being just cervical to the junction between the occlusal and middle thirds.

The root outline resembles that of the canine but is shorter by about 3-4 mm and shows a distal curvature at the apex.

Lingual aspect

Lingual aspect is much narrower mesiodistally than buccal since the crown and root taper markedly toward the lingual side. The lingual surface is evenly convex in all directions.

The mesial and distal outlines are concave between the cervical line and the contact areas. The contact areas and marginal ridges are pronounced and extend out above the narrow cervical portion of the crown. The mesial marginal ridge is more cervically located than the distal one.

The cervical line is slightly convex toward the root. The occlusal surface slopes greatly toward the lingual surface down to the short lingual cusp. Accord-

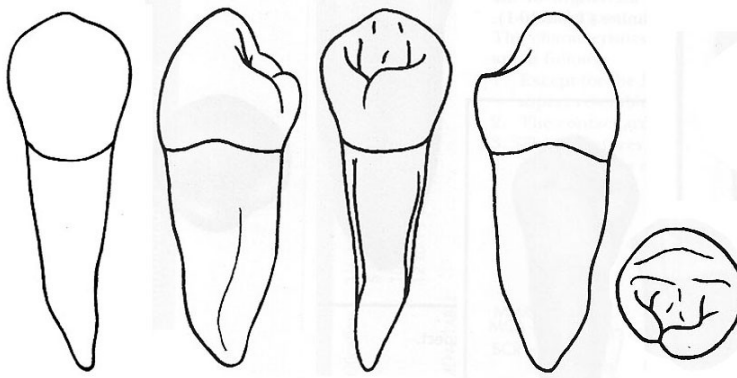


Fig. 33. Surface characteristics of mandibular right first premolar from left-to-right buccal, mesial, distal, lingual and occlusal aspect.

ingly most of the occlusal surface is seen from this aspect.

A mesiobuccal developmental groove separates the mesial marginal ridge from the lingual cusp. The groove fades out at the junction of the middle and cervical thirds.

The root tapers evenly from the cervix to a pointed apex. A narrow smooth convex ridge is seen through the full length of the root. Often developmental depression in the root with developmental grooves mesially and distally are seen.

Mesial aspect

Crown outline is rhomboidal which is a characteristic of all mandibular posterior teeth from mesial and distal aspect.

The surface of the crown presents an overhang above the root in a lingual direction. The tip of the lingual cusp is on a line with the lingual border of the root (both the buccal and lingual roots of the maxillary premolars are within the confines of the root trunk).

The tip of the buccal cusp is nearly centered or a little buccal to the center of the root.

The buccal outline of the crown is convex with the crest of curvature near the cervical one third. This feature is a characteristic for buccal surface of all posterior teeth. The lingual outline is less convex and the crest of curvature approaches the middle third.

The mesial marginal ridge has a sharp inclination lingually in a cervical direction (45°), the lingual border of which merges with the developmental depression mesiobuccally. This depression harbors the mesiobuccal developmental groove.

The contact area is ovoid in shape and is located to the junction of the occlusal and middle thirds and slightly buccally.

Some of the mesial portion of the occlusal surface is seen from this aspect, this includes mesial portion of the buccal cusp triangular ridge and mesial marginal ridge.

The cervical line curves occlusally and the crest of curvature is about 1mm in extent and is centered buccolingually.

The mesial surface is convex at the mesial contact area then becomes sharply concave till the cervical line.

The root outline tapers to a pointed apex in line with the tip of the buccal cusp. Deep developmental groove is shown in the center of the root which may end in bifurcation at the apex.

Distal aspect

It differs from the mesial aspect in the following:

- Distal marginal ridge is more occlusally located and nearly at line angle to the axis of the crown and root.
- The distal contact area is broader than the mesial and is centered buccolingually in the middle one third.
- Curvature of cervical line is nearly the same as in the mesial aspect.
- The root surface is more convex distally.
- A shallow developmental depression is centered on the root but with no developmental groove

Occlusal aspect

This aspect shows considerable variations on the outline. It may be diamond-shaped, similar to the incisal aspect of canine, or circular similar to some second premolars. The characteristics common to all mandibular first premolars from the occlusal aspect regardless of the type are listed in table XIII.

Table XV. Characteristics of occlusal aspect of first mandibular premolar

- The middle buccal lobe makes the major bulk of the crown.
- The lingual marginal ridge is convex and is interrupted mesially by the mesiolabial developmental groove.
- The mesiobuccal and distobuccal line angles are prominent even though rounded.
- The curvature representing the contact areas are broad and the distal is broader.
- The crown converges sharply to the center of the lingual surface, which gives the crown a triangular appearance with the base at the buccal cusp and the apex at the lingual cusp.
- The marginal ridges are well developed.
- The lingual cusp is small.
- The buccal triangular ridge is heavy and the lingual one form a transverse ridge.
- Mesial and distal triangular fossae are two irregular depressions containing pits.
- The mesiolingual developmental groove constricts the mesial surface of the crown and create a smaller contact area.
- The mesial triangular fossa of the occlusal surface is more linear in form.
- The mesiobuccal groove extends buccally from mesiotriangular fossa and the mesiolingual groove extends from it lingually.
- The distal triangular fossa is more circular.
- The central developmental groove extends from the mesial to the distal pits of the fossae.

The pulp cavity

It resemble that of the canine but smaller in dimensions.

In buccolingual section the pulp chamber is wide with clear pulp horn under the buccal cusp. The pulp horn directed to the lingual cusp is missing. The root canal is broad tapering evenly and is more constricted at halfway point of root length.

Mesiodistally the pulp chamber and root canal are narrow and the canal taper evenly until the constricted apical foramen. This is typical for all premolars.

Cervical cross section shows wider pulp canal buccolingually than mesiodistally. The outline form may be oval, rectangular or triangular. Occasionally two canals may be seen.

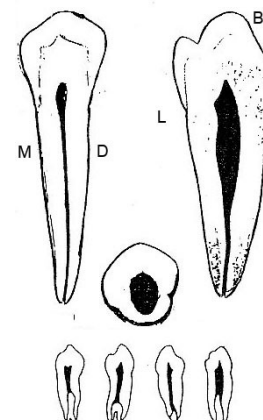
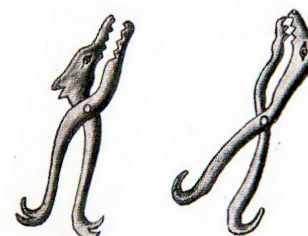


Fig. 34. pulp cavity characteristics of lower right first premolar. Mesiodistal section (upper left), buccolingual section (upper right) and cervical cross section (upper middle) and possible variation (lower).

These ancient Indians forceps were used for extraction of teeth and were named for the resemblance to the head of an animal. The right forceps is called "Cat" and the left "Jackal". The forceps were used to extract teeth as well as foreign bodies such as arrow heads.

**Mandibular second premolar**

The crown of the mandibular second premolar is wider buccolingually by 0.5 mm than the mandibular first premolar. Its lingual cusps are more developed, and both marginal ridges are higher. This produces a more efficient occlusion with the maxillary antagonist. Therefore, a mandibular second premolar functions more like molar than a canine.

There are two common forms which this tooth assumes;

- The three cusp type, which is the most common and appears more angular from the occlusal aspect.
- The two-cusp type appears more rounded from the occlusal aspect.

The single root of the second premolar is longer (by 0.5 mm) than that of the first premolar with developmental groove buccally in many cases.

Buccal aspect

From the buccal aspect the crown resembles a first premolar in its general shape. It presents shorter buccal cusp than the first premolar with the mesiobuccal and distobuccal cusp ridges more rounded and less pointed cusp tip which is little mesial to the tooth center. The mesial and distal contact areas are nearly at the same level but are broader and placed higher occlusally. The buccal ridge is prominent than that of the mandibular first premolar.

The root is longer and broader mesiodistally than the first premolar and ends in more blunt apex. The single root may show a developmental groove.

Lingual aspect

The lingual lobes are developed to a greater degree making the cusp or cusps longer. In the three cusp type, there are a mesiolingual and a distolingual cusps. The former is the wider and longer of the two cusps. The cusps are divided by a lingual groove.

In the two cusp type, the single lingual cusp is higher than on a mandibular first premolar. There is no groove, but a developmental depression is seen distolingually where the lingual cusp ridge joins the distal marginal ridge.

Table XVI. Chronology of mandibular second premolar

Dental Organ Appearance	8MIU
Start Calcification	21/3-21/2 Y
Enamel Completed	6-7 Y
Eruption	11-12Y
Root Completed	13-15 Y

The lingual surface of the crown of all mandibular second premolars is smooth and spheroidal, having a bulbous form above the constricted cervical portion.

The root is much wider lingually than that of the first premolar. This results in less convergence towards lingual. It is smooth and convex.

Mesial aspect

The second premolar differs from the first from the mesial aspect in the following ways;

- The crown and root are thicker buccolingually than the first premolar.
- The buccal cusp is shorter and its tip located more to the buccal side.
- The lingual lobe or lobes development is greater. The tip of the lin-

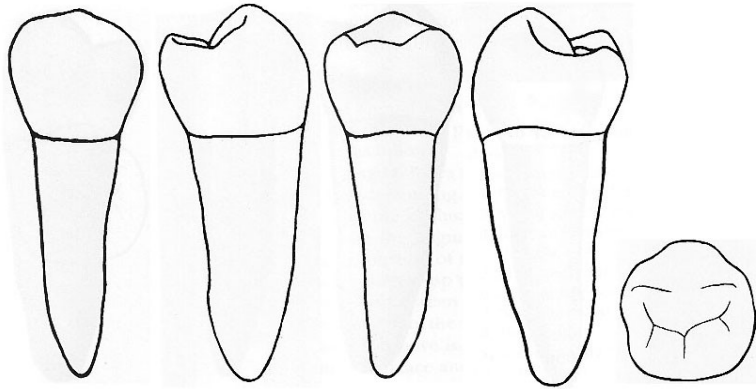


Fig. 35. Surface characteristics of mandibular left second premolar from left-to-right buccal, mesial, distal, lingual and occlusal aspect.

gual cusp is on line with the lingual border of the root.

- The marginal ridge is at right angle to the long axis of the tooth.
- Less of the occlusal surface may be seen.
- There is no mesio-lingual developmental groove on the crown portion.
- The root is longer and in most cases slightly convex on the mesial surface with a more blunt apex.

Distal aspect

More of the occlusal surface can be seen because the distal marginal ridge is at a lower level than the mesial marginal ridge.

As a general rule, the crown of all posterior teeth (maxillary and mandibular) are tipped distally to the long axis of the root. So, much of the occlusal surface may be seen from the distal aspect.

In the three-cusp type both lingual cusps are seen since the distolingual cusp is shorter than the mesiolingual cusp.

The root is conical in shape and may show deeper developmental depression.

Occlusal aspect

In both the two and three-cusp forms, the buccal cusp is similar, however, the outline of each type shows some variations from the occlusal aspect.

The occlusal characteristics of the three cusp type:

- It appears **square** lingual to the buccal cusp ridge. It has three distinct cusps, the buccal cusp is the largest then the mesiolingual cusp. The distolingual cusp is the smallest.
- Each cusp has a well defined triangular ridges separated by deep developmental grooves. These grooves converge in a central pit and from a "Y" shape on the occlusal surface. Three pits may be present, a central, a mesial and distal.
- The central pit is located in the center buccolingually and slightly distal to the midway point between the mesial and distal marginal ridges.
- From the central pit, a mesial and distal developmental grooves travel in a mesiobuccal and distobuccal directions respectively ending in the mesial and distal triangular fossae.
- The lingual developmental groove extends lingually between the two lingual cusps and ends on the lingual surface of the crown just below the lingual cusps. The mesiolingual cusp is wider mesiodistally than the distolingual cusp.
- Supplemental grooves and depressions are often seen radiating from the developmental groove.
- The mesial and distal marginal ridges are confluent with the cusp ridges.

The occlusal characteristics of the two-cusp type as compared with the three-cusp type are:

- The outline of the crown is **rounded**.
- The lingual surface of the crown is more convex and tapers toward the lingual side (lingual convergence)

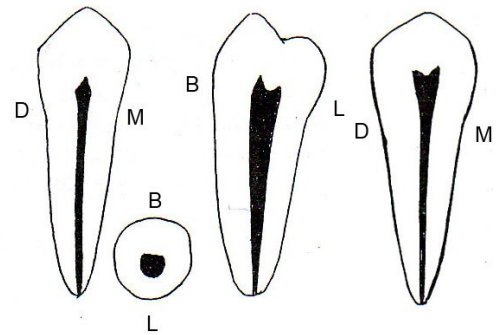


Fig. 36. Pulp cavity characteristics of lower left second premolar. Mesiodistal section (left), buccolingual section (middle), cervical cross section (next to left) and mesiodistal section of three cusp type (right).

- The mesiolingual and distolingual line angles are rounded.
- There is only one well-developed lingual cusp located directly opposite to the buccal cusp in a lingual direction.
- There is no lingual developmental groove.

A central developmental groove is seen on the occlusal surface traveling in a mesiodistal direction. This groove may be straight and often crescent-shaped. The groove pattern can be either a "U" or "H" groove pattern, depending on whether the central developmental groove is straight mesiodistally or curves buccally at its ends. The central groove of the two-cusp form terminates in a mesial and distal fossae. There is usually no central pit, a mesial or distal pit is much more likely. Usually the two-cusp type shows a transverse ridge.

**THE TOOTH IS A
NOBLE ORGAN THAT
CAN NOT BE REPLACED**

The pulp cavity

In buccolingual section it resembles that of the mandibular first premolar, but is larger in size, and the roof of the pulp chamber is pointed to accommodate more than one pulp horn. The lingual pulp horn is smaller than the buccal pulp horn.

In mesiodistal section it resembles that of the mandibular first premolar except for the added size and length.

The pulp chamber has three pulp horns in the three-cusp type. The largest is the buccal pulp horn then the mesio lingual then the distolingual.

In cervical cross section the outline of the pulp cavity follows that of the root and most commonly is rectangular. ■

The Molars

General features

- There are twelve permanent molars three in each quadrant. They are the largest and strongest teeth in the mouth by their crown bulk size and their root anchorage in the bone.
- The molars have No deciduous predecessors. Generally the lower first molars are formed from five lobes, but second and some third molars may have only four. Each cusp of a molar is formed from its own lobe.
- The most developed of the molar is the first molar. The third molar exhibits the most variable morphology in the mouth.
- Molars are used in grinding food, but most important they support and maintain the vertical dimension of the face.

Maxillary Molars

They are six in number, three in each side, the first, second, and third molars.

Maxillary First Molar

The normal location of the first permanent molar is at center of the fully developed adult dental arch antero-posteriorly. Table XV shows the chronology of the first maxillary molar.

It is the largest tooth in maxillary arch. It has four well developed cusps (two buccal and two lingual) and a fifth supplemental nonfunctioning elevation which is called **Tubercle of Carabelli**. This fifth cusp serves to identify the maxillary first molar. The crown of this tooth is wider buccolingually than mesiodistally.

There are three well developed and widely separated roots, two buccal and one palatal (lingua). They give this tooth the maximum anchorage against forces.

Buccal aspect

The crown is roughly trapezoid. The cervical line is the shortest of the uneven sides. The tips of all cusps are usually visible from this aspect. Part of the distal side is seen due to the obtuse distobuccal line angle.

The mesial outline of the crown follows a nearly straight path downward and mesially, curving occlusally as it reaches the crest of contour of the mesial surface which is the contact area. The contact area is just Cervical to the junction of the occlusal and middle thirds. Then, the mesial outline curves occlusally and distally and becomes corresponding with the outline of the mesial slope of the mesiobuccal cusp.

The distal outline is convex, from the cervical line to the contact area is in the center of the middle third then it curves occlusally and mesially to outline and distal slope of the distobuccal cusp.

The cervical line is slightly curved with the curvature root wise. This line is not so smooth and regular as found in some other teeth.

Although the mesiobuccal cusp is broader than the distobuccal cusp, the distobuccal cusp is usually sharper and longer. The mesial slope of the mesiobuccal cusp meets its distal slope at an obtuse angle. The mesial slope of the distobuccal cusp meets its distal slope at approximately right angle.

Separating the two buccal cusps is the buccal developmental groove. This shallow groove runs in occluso-apical direction parallel to the long axis of the distobuccal root. It terminates at a point nearly half the distance from its origin as a horizontal groove.

The buccal surface is characterized by buccal ridges on each buccal cusp. They are convex areas which extend cervically about half its length. It is also characterized by the buccal cervical ridge which extends horizontally from mesial to distal in the entire cervical third.

The molar roots originate as a single root on the base of the crown, and then they divide into three roots. The common root base is called root trunk. Usually the palatal root is the longest and the two buccal roots are approximately equal in length. The root are about twice as long as the crown and their greatest extremities mesiodistally is less than the calibration of the crown mesiodistally.

Table XVII. Chronology of maxillary first molar

Dental Organ	Appearance	4MIU
Start Calcification	At birth	
Enamel Completed	3-4 Y	
Eruption	6-7Y	
Root Completed	9-10 Y	

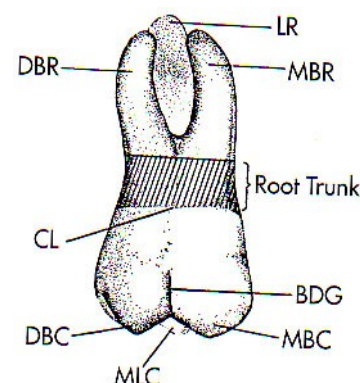


Fig. 37. Maxillary right first molar, buccal aspect. DBR, distobuccal root; LR, lingual root; MBR, mesiobuccal root; CL, cervical line, DBR distobuccal cusp; MLC, mesiolingual cusp; BDG, buccal developmental groove; MBC, mesiobuccal cusp

There is a deep developmental groove buccally on the root trunk which starts at the bifurcation and progresses downward to end in a shallow depression at the cervical line.

All three roots may be seen from the buccal aspect. The point of bifurcation of the two buccal roots is located approximately 4mm above the cervical line. The roots are not straight; the buccal roots are curved halfway between the point of bifurcation and the apices.

The mesiobuccal root curves distally starting at the middle third to the apex. Its long axis at an acute angle distally with the cervical line. It has a tendency toward curvature mesially at the middle third.

Lingual Aspect

It is Trapezoid in shape. The crown surface shows more convexity occlusocervically than the buccal surface. The height of contour is located in the middle third of the surface. The lingual cusps are the only ones to be seen from this aspect. The mesiolingual cusp is much larger. Its mesiodistal width is about $\frac{3}{5}$ th of the mesiodistal diameter of the crown, the distolingual cusp making up the remaining $\frac{2}{5}$ th.

The mesial outline is straight from the cervical line to the contact area and

meets the mesial slope of the mesiolingual cusp at 90°. The two cusp slopes meet at obtuse angle. The distal outline of the crown is smoothly curved. The cervical line is slightly convex rootwise in an irregular manner.

The fifth cusp (Tubercle of Carabelli) appears attached to the mesiolingual surface of the mesiolingual cusp. The fifth cusp is separated from the mesiolingual cusp by an irregular developmental groove. This is called the fifty cusp developmental groove.

The distolingual cusp is smooth and spheroidal without angulation on the mesial and distal slopes. The lingual developmental groove separates the two large lingual cusps and runs cervically to end at the center of the lingual surface of the crown. From this point a shallow depression extends cervically and continues in an apical direction on the lingual root till the middle third.

All three roots are visible from the lingual aspect. The lingual portion of the crown linguallly. The lingual root is conical with blunt rounded apex. The apex of the lingual root is on line with the lingual groove of the crown.

Mesial aspect

It is trapezoid in shape with the smallest uneven side located occlusally. The buccal outline of the crown starting from the cervical line is curved with the crest of curvature within the cervical third. As it progresses downward, it becomes less convex to circumscribe the mesiobuccalcusp. Only the mesiobuccal, mesiolingual and the fifth cusps are seen. Also only two roots are seen, the mesiobuccal and the palatal roots.

The lingual outline is curved with the crest of curvature located near the middle third. If the tubercle is well developed, the lingual outline dips inward to illustrate it. If it is undeveloped the lingual outline continues from the crest of curvature as a smooth curved arc to the tip of the mesiolingual cusp.

The mesial marginal ridge, which is confluent with the mesiobuccal and mesiolingual cusp ridges, is irregular and curved cervically about one-fifth the crown length. The cervical line is irregular, curving occlusally not more than 1mm.

The mesial contact area is above the marginal ridge approximately cervical to the junction of the middle and occlusal thirds of the crown and some what toward the buccal side. Just above it, a shallow concavity is found which may continue to the mesial surface of the root trunk at its cervical third.

The mesiobuccal root is broad and flattened on its mesial surface. The width of this root at the point of bifurcation is about $\frac{2}{3}$ of the crown width at the cervical line buccal-lingually. The buccal outline of this root is curved, but its lingual outline is straight to end at a blunt apex.

The lingual or (palatal) root is longer than the mesiobuccal root by 1.0mm but it is narrower from this aspect. Its buccal outline is concave and its lingual outline is convex. At its middle and apical thirds, it is outside of the confines of the greatest crown projection. It is banana shaped.

The level of the bifurcation is a little closer to the cervical lie than is found between the roots buccally. There is smooth depression extends from the bifurcation to the cervical line.

Distal aspect

The gross outline of this aspect is similar to that of the mesial aspect, but the following variation is noted.

- The buccolingual measurement of the crown on the distal aspect is less than that of the mesial aspect.
- The distal marginal ridge dips sharply in a cervical direction exposing part of the four cusps.
- The cervical line is almost straight.
- The distalsurface is generally convex except for a small concave area near the distobccal root at the cervical third. This concavity continues over the distobuccal root and end at the bifurcation point.
- The distobuccal root is narrow at its base than either of the others. Its outline follows a concave path from the cervical line for a short distance than makes a convex arc to the blunt apex. The lingual outline of this root is slightly concave from the apex to the bifurcation.
- The bifurcation is more apical. The area from the cervical line to bifurcation is 5mm or more in extent.

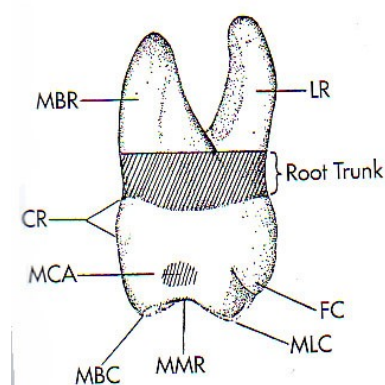


Fig. 38. maxillary right first molar, mesial aspect. LR, lingual root; FC, fifth cusp; MLC, mesiolingual cusp; MMR, mesial marginal ridge; MBC, mesiobuccal cusp; MCA, mesial contact area; CRm cervical ridge; MBR, mesiobuccal root.

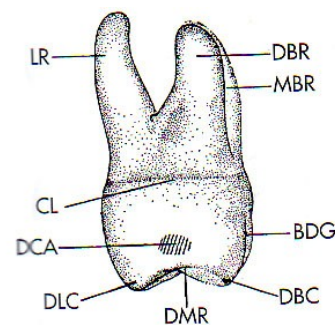


Fig. 39. maxillary right first molar, distal aspect. DBR, distobuccal root; MBR, mesiobuccal root; BDG, buccal developmental groove; DBC, distobuccal cusp; DCA, distal contact area; CL, cervical line; LR, lingual root; DLC, distolingual cusp; DMR, distal marginal ridge.

Occlusal aspect

It is Rhomboidal in outline, the crown is wider mesially than distally, and wider lingually than buccally (this the only molar that is wider lingually than buccally).

The mesiobuccal and distolingual angles are acute in comparison to the mesiolingual and distobuccal angles which are comparatively obtuse.

The four major cusps are well developed. The tubercle of Carabelli on the lingual surface of the mesiolingual cusp is small and nonfunctional. It may be indistinct, and instead, a developmental line in the enamel is present.

The mesiolingual cusp is the largest cusp, followed by the rounded mesiobuccal, the sharp distobuccal, the small distolingual, and the nonfunctional fifth cusp (**tubercle of Carabelli**).

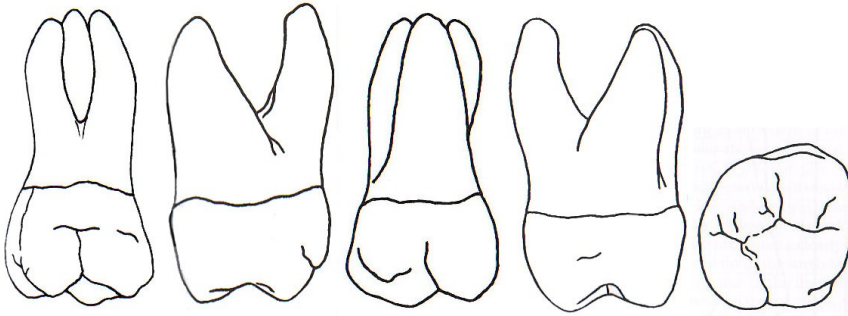


Fig. 40. Surface characteristics of maxillary right first molar. From left-to-right buccal, mesial lingual, distal and occlusal aspects.

The occlusal surface is within the confines of the cusp ridges and the marginal ridges.

There are two major fossae, a central fossa which is triangular concave area mesial to the oblique ridge, and a distal fossa which is to the distal marginal ridge.

The central developmental pit lies in the central fossa. The buccal developmental groove radiates from this pit buccally between the two buccal cusps. The central developmental groove proceeds in a mesial direction originating in the central pit and termination at the mesial triangular fossa. The mesial pit is found in the mesial triangular groove and crosses the mesial marginal ridge.

From the mesial pit the following developmental grooves radiate.

- The central developmental groove to the central fossa.
- The mesiobuccal groove.
- The mesiolingual groove.

Another developmental groove may be seen radiating from the central pit distally and crosses the oblique ridge to end at the distal fossa. This is called the Transverse groove of the oblique ridge.

From the distal pit the following developmental grooves radiate:

- The distal groove that joins the distal triangular and distal fossa.
- The distal marginal groove that may extend over the marginal ridge into the distal surface.
- The distolingual groove.
- The distobuccal groove.

The oblique ridge traverses the occlusal surface from the top of the mesiolingual cusp to the top of the distobuccal cusp. It is reduced in height in the center of the occlusal surface and is sometimes crossed by the transverse groove of the oblique ridge.

The mesial and distal marginal ridges are irregular elevations of enamel which are confluent with the adjacent cusp ridges.

Pulp cavity

It contains a pulp chamber and three or four root canals.

In *buccolingual section* the chamber is broad and rectangular in shape and the two pulp horns are prominent and extend to the mesiobuccal and mesiolingual cusps. The floor is smooth with canal openings widening out as they enter the

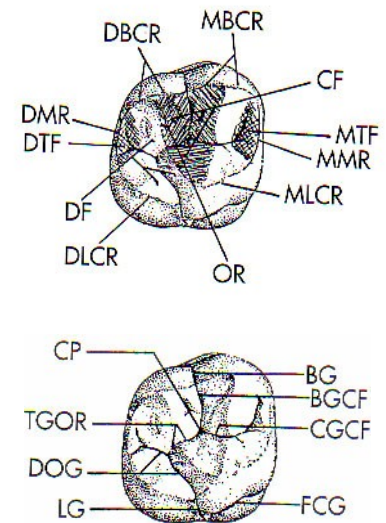


Fig. 41. Maxillary right first molar, occlusal aspect (upper) and developmental grooves (lower).

(Upper) MBCR, mesiobuccal cusp ridge; CF, central fossa (shaded area); MTF, Mesial triangular fossa (shaded area); MMR, mesial marginal ridge; MLCR, mesiolingual cusp ridge; DF, distal fossa; DTF, distal triangular fossa (shaded area); DMR, distal marginal ridge; DBCR, distobuccal cusp ridge; DLCR, distolingual cusp ridge; OR, oblique ridge. (Lower) BG, buccal groove; BGCF, buccal groove of central fossa; CGCF, central groove of central fossa; FCG, fifth cusp groove; LG, lingual groove; DOG, distal oblique groove; TGOR, transverse groove of oblique ridge; CP, central pit.

pulp chamber. The lingual canal is large and accessible, while the mesiobuccal canal is small and shorter and it may have supplementary branches and multiple foraminae, but mostly the mesiobuccal root has two root canals which either open in one or two aical foramina. The distobuccal root has only one root canal.

In *mesiodistal section* The pulp chamber is not wide, and the pulp horns extend to the mesio-buccal and distobuccal cusps. The mesiobuccal and distobuccal canals are narrow and tapering to the apex. The pulp chamber the two root canals are centered within the tooth outlines.

In *cervical cross section* The outline is rhomboidal in shape with rounded corners. The canals of this tooth form a triangular pattern. A line drawn between the mesiobuccal and the palatal canals makes the base of the triangle.

In *midroot cross section* The palatal root canal is rounded in outline. The distobuccal canal is oval and smaller. The mesiobuccal canal or canals are elongated oval or kidney shaped. ■

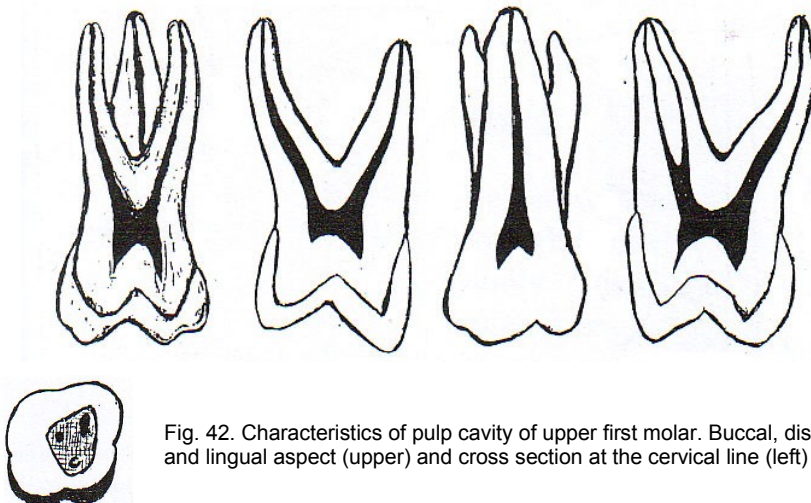


Fig. 42. Characteristics of pulp cavity of upper first molar. Buccal, distal, and lingual aspect (upper) and cross section at the cervical line (left)

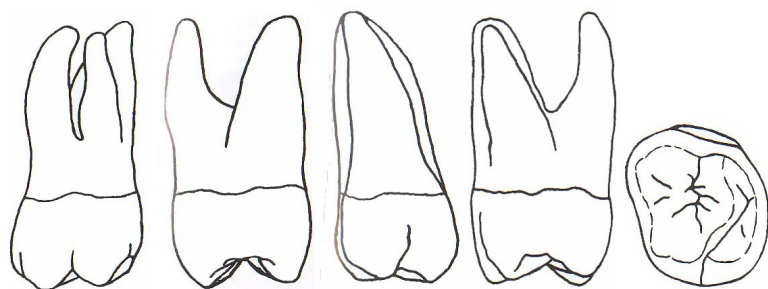


Fig. 43. Surface characteristics of maxillary left second molar. From left-to-right buccal, mesial lingual, distal and occlusal aspects.

Table XVIII. Chronology of maxillary second molar

Dental Organ Appearance	One Year
Start Calcification	2.5-3 Y
Enamel Completed	7-8 Y
Eruption	12-13 Y
Root Completed	14-16 Y

Maxillary Second Molar

This tooth assists the maxillary first molar in function, and it has the same form with some variations.

Buccal aspect

The crown is a little shorter cervico-occlusally (by about 0.5mm) narrower mesiodistally (by 1mm), but of the same measurement bucco-lingually.

The buccal groove is located further distally, with a resultant larger and longer mesiobuccal cusp, and a shorter, smaller and sharper distobuccal cusp.

The buccal roots are about the same length. They are more nearly parallel and are inclined distally more than those of the maxillary first molar so that the end of the distobuccal root is slightly distal to the distal extremity of the crown.

The apex of the mesiobuccal root is on a line with the buccal groove of the crown instead of the tip of the mesiobuccal cusp as found on the first molar.

Lingual aspect

- The mesiolingual cusp is smaller and not well developed as in the first maxillary molar. No fifth cusp is present.
- The distolingual cusp is smaller.
- The buccal cusps may be seen between the lingual cusps.
- The apex of the lingual root is in line with the distolingual cusp instead of the tip of the lingual groove as was found on the first molar.

- There is no developmental groove on the palatal root.

Mesial aspect

No tubercle of Carabelli. It shows less divergent roots (being within the confines of buccolingual crown outline). In addition the cervical concavity is not present.

Distal aspect

It is similar to the mesial except that the distobuccal cusp is smaller than in the first molar. The apex of the lingual root is in line with the distolingual cusp.

Occlusal aspect

The crown is more constricted mesiodistally and has no tubercle of Carabelli. There are two major types of crown form:

Rhomboidal form which is most frequent type resembling the maxillary first molar except that:

- The rhomboid form is more accentuated.
- The acute angle is less acute, and the obtuse angles are greater.
- The distobuccal and distolingual cusps are smaller.

Heart shaped form resembles the maxillary third molar. The distolingual cusp being poorly developed or sometime missing.

It is common to find supplemental grooves as well as grooves and pits on

the occlusal surface of the maxillary second molar which make the surface more wrinkled.

Pulp cavity

It is similar to the first maxillary molar both in the mesiodistal and buccolingual cross sections. It is not common to find two root canals in the mesiobuccal root.

Maxillary Third Molar

The maxillary third molar is the most variable tooth in the upper arch. It varies in size, shape, contour and surface details. The most common crown shape is the heart-shape, which is generally smaller and more rounded in all dimensions than the second molar and also the crown is shorter and narrower.

The distolingual cusp is very small and poorly developed or may be absent presenting an occlusal table with three cusps. The groove pattern is variable and may show many supplementary grooves and the distolingual groove is absent.

The root form and number are extremely variable, but are smaller in all dimensions. The most common is the three root type where they are often fused

Pulp cavity

Due to the variation in shape of this tooth the pulp cavity also subjected to great variation in shape and size. However, the pulp cavity roughly follows the shape of the tooth.

Table XIX. Chronology of maxillary third molar

Dental Organ Appearance	4Y
Start Calcification	7-9 Y
Enamel Completed	12-16 Y
Eruption	17-21 Y
Root Completed	18-25 Y

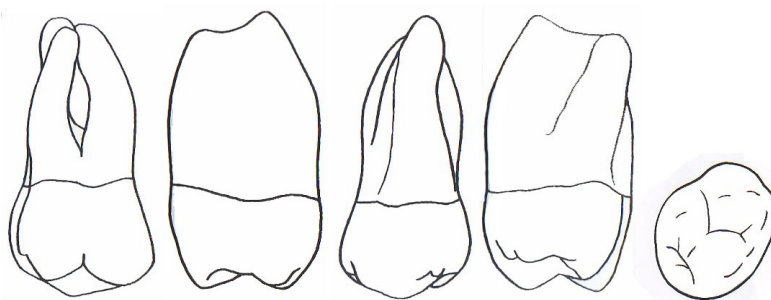


Fig. 45. Surface characteristics of maxillary left second molar. From left-to-right buccal, mesial lingual, distal and occlusal aspects.

Mandibular Molars

They are six in number, three on each side of the mandible. (The are larger than any mandibular teeth. The crowns are quadrilateral being some what longer mediolaterally than buccolingually). The crowns of the mandibular molars are shorter cervico-occlusally than the other mandibular teeth. The possess two roots, one mesial and one distal.

Mandibular First Molar

It is the largest tooth in the mandibular arch. It has five well-developed cusps, two buccal two lingual and distal cusp, so it is formed of five lobes. Occasionally four cuspid first molar is formed with the distobuccal and distal cusps fused with little or no distobuccal developmental groove.

It has two well developed roots, one mesial and one distal which are very buccolingually. The roots are widely separated at the apices. The most abnormal finding is to see a thin slender long root originated lingual and adjacent to the mesial root.

Buccal aspect

The outline is **trapezoid** with the long side occlusally. It is wider mesiodistally than occlusocervically. The five cusps are in view from this aspect (the two buccal cusps, the buccal portion of the distal cusp and the tips of the two lingual cusps). The developmental grooves appear on the crown.

The mesiobuccal developmental groove which demarcates the mesiobuccal cusp from the distobuccal cusp is situated a little mesial to the root bifurcation. It originates from the occlusal and extends onto the buccal surface of the crown ending with a pit.

This distobuccal development groove is longer than the other and separates the distobuccal cusp from the distal cusp from the distal cusp. It has its terminus near the cervical third of the crown.

The cervical ridge is a heavy mesiodistal ridge along the cervical third of the surface. It is more prominent in its mesial portion. The cervical line is regular in outline and curved root wise.

The mesial outline of the crown is convex in the occlusal third to the contact area and becomes concave to the cervical line. The mesial contact area is located at the junction of the occlusal and middle thirds.

The distal outline is more convex in the occlusal portion than the mesial outline, and straight from the cervical line to the distal contact area which is near the crown centre cervico-occlusally.

The buccal cusps are flat with less curved ridge (which is characteristic for mandibular molar). The mesiobuccal cusp is the widest mesiodistally and the distobuccal cusp, is less wide.

The mesial root curves mesially from a point shortly below the cervical line to the middle third, then curves distally to tapered apex which is located below the mesiobuccal cusp. The distal outline of the mesial root is concave from the bifurcation of the trunk to the apex.

The distal root is less curved than mesial. The apex is more pointed and is located below or distal to the distal contact area of the crown.

Both roots are wider mesiodistally at the buccal surface than they are lingually. Developmental depressions are present on the mesial and distal sides. The point of bifurcation of the two roots is located approximately 3mm below the cervical line. There is a deep developmental depression on the root trunk from the bifurcation ending immediately above the cervical line.

Lingual aspect

It is **trapezoid** and is smaller than the buccal aspect due to the convergence of the mesial and distal surfaces. The mesial outline of the crown is convex from the cervical line to the marginal ridge with the crest of curvature at the contact area.

The distal outline is straight or slightly concave above the cervical line to the distal contact area and becomes convex to the occlusal margin. The contact area is lower than on the mesial side located in the middle third.

Table XX. Chronology of mandibular first molar

Dental Organ Appearance	4 MIU
Start Calcification	At birth
Enamel Completed	2.5-3 Y
Eruption	6-7 Y
Root Completed	9-10 Y

It shows two pointed lingual cusps with high cusp ridges as well as the lingual part of the distal cusp. The mesiolingual cusp is the widest mesiodistally and its cusp tip is higher than the distolingual cusp. The mesiolingual and distolingual cusp ridges form obtuse angles at the cusp tips. The two lingual cusps are separated by the lingual developmental groove which extends downward on the lingual surface of the crown for a short distance to the junction of the occlusal and middle thirds. The distal cusp is at a lower level than the mesiolingual and distolingual cusps.

The cervical line is irregular and is sharply pointed toward the bifurcation of the root.

The roots are longer by 1mm lingually than buccally. The root trunk is also 1mm longer, the root bifurcation starts at about 4 mm. It shows deep developmental depression from the point of bifurcation progresses cervically and fades out entirely immediately below the cervical line. The bifurcation groove of the crown.

Mesial aspect

It is rhomboidal, wider at the cervical margin than at the occlusal margin. From this aspect the mesiobuccal and mesiolingual cusps together with the mesial root are seen. The entire crown has a lingual tilt in relation to the root axis (the maxillary posterior teeth have the centre of the occlusal surfaces between the cusps in line with the root axis).

The buccal outline is convex immediately above the cervical line which outlines the buccal cervical ridge. Above the cervical ridge, the buccal contour becomes flat till the contour of the mesiobuccal cusp. The mesiobuccal cusp is located directly above the buccal third of the mesial root.

The lingual outline is straight from the cervical line to join the curvature at the middle third then becomes curved till tip of the mesiolingual cusp. The crest of curvature is located at the centre of the middle third of the crown. The mesiolingual cusp tip is located directly above the

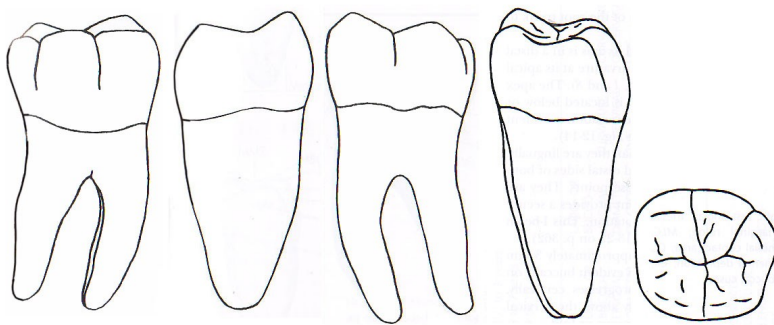


Fig. 45. Surface characteristics of mandibular right first molar. From left-to-right buccal, mesial lingual, distal and occlusal aspects.

lingual third of the mesial root.

The mesial marginal ridge is continuous with the mesial ridges of the mesiolingual and mesiobuccal cusps, but is below the cusp tip by 1 mm.

The surface of the crown is convex and smooth over the cusps. A slightly concave area exists at the cervical line immediately above the centre of the mesial root. Above this area is the contact area which is rounded to slightly ovoid in shape and located at the junction of the middle and occlusal thirds almost centred buccolingually.

The root outline is almost straight buccally and lingually and then becomes convex on both sides to taper to a blunt apex which is located directly below the mesiobuccal cusps. The mesial surface of the root is convex with broad concavity in the centre for the full length of the root. The apex is usually bifid at the apical third.

Distal aspect

The gross outline is similar to the mesial aspect, but the crown is shorter distally, and the buccal and lingual surfaces converge distally. From this aspect part of the occlusal surface and part of each of the five cusps are seen due to the distal inclination of the crown to the long axis.

The distal, distobuccal and distolingual cusps are clearly seen. The distolingual cusp is the largest of the three cusps, and the distal is the smallest.

The distal marginal ridge is short and dips sharply in a cervical direction and developmental groove or depression is found crossing it at this point.

The end of the distobuccal developmental groove is located on the distal surface, forming a convexity at the cervical portion of the distobuccal line angle of the crown.

The distal contact area is located below the distal cusp and is centered over the distal root near the crown center cervico-occlusally. It is larger than the mesial contact area.

The distal surface of the crown is convex except above the cervical line where it becomes flat and joins the flattened surface of the root trunk distally.

The distal root is narrow buccolingually than the mesial root. The distal and mesial surfaces of the root are smooth and flat with a shallow developmental depression on the distal surface. The apical third of the root is more rounded and tapers to a sharper apex than is found in the mesial root. The lingual border of the mesial root may be seen from the distal aspect.

Occlusal aspect

The crown is hexagonal from the occlusal aspect. It is 1 mm greater mesiodistally than buccolingually (which is the opposite for the maxillary molars). It has five cusps, the mesiobuccal cusp is slightly larger than the lingual cusps which are nearly equal, then followed by the distobuccal cusp. The distal cusp is the smallest of all. Sometimes the first molar has four cusps when the distobuccal and distal cusps fuse. The crown converges lingually and distally.

The occlusal surface has a major central fossa and two minor fossae. The central fossa is concave and circular. It is centrally placed on the occlusal surface between the buccal and lingual cusp ridges. The two minor fossae are the mesial triangular fossa and the distal triangular fossa just distal and mesial to the marginal ridge respectively. The distal fossa is smaller and shallower than the mesial fossa. The central groove has its

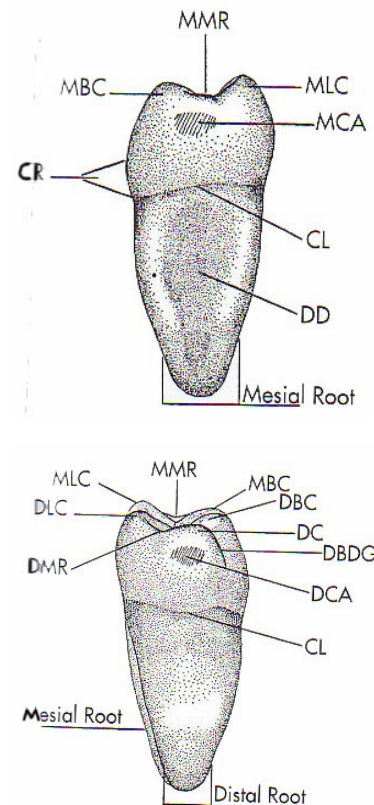


Fig. 46. Mandibular right first molar, mesial aspect (upper) and distal aspect (Lower). MMR, mesial marginal ridge; MLC, mesiolingual cusp; MCA, mesial contact area; CL, cervical line; DD, developmental depression; CR, cervical ridge; MBC, mesiobuccal cusp. (upper) MMR, mesial marginal ridge; MBC, mesiobuccal cusp; DBDG, distobuccal developmental groove; DCA, distal contact area; CL, cervical line; DMR, distal marginal ridge; DCL, distolingual cusp; MLC, mesiolingual cusp (lower)

two has its two terminals in each fossae.

From the central fossa at the central pit many developmental grooves radiate. These are, the central developmental groove which in a zigzag manner runs and ends on either side in the triangular fossae. Sometimes it crosses the distal marginal ridge and continues as a shallow groove for a small distance on the distal surface. A short distance from the central pit, the central groove joins the mesiobuccal developmental groove which separates the mesiobuccal and distobuccal cusps.

The developmental groove of the surface is irregular, crossing in a lingual direction to the junction of the lingual cusp ridges.

The distobuccal developmental groove extends from the central fossa to pass between the distobuccal and distal cusps. Supplemental grooves and developmental pits may also be found on the occlusal surface. Buccal and lingual sup-

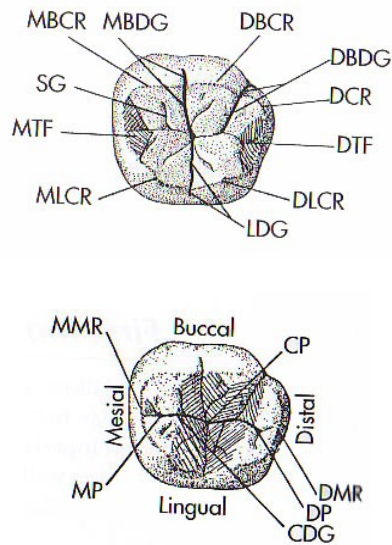


Fig. 47. Mandibular right first molar, occlusal aspect.

DBCR, distobuccal cusp ridge; DBDG, distobuccal developmental groove; DCR, distal cusp ridge; DTF, distal triangular fossa (shaded area); DLCR, distolingual cusp ridge; LDG, lingual developmental groove; MLCR, mesiolingual cusp ridge; MTF, mesial triangular ridge (shaded area); SG, supplemental groove; MBCR, mesiobuccal cusp ridge; MBDG, mesiobuccal developmental groove (upper); Central fossa (shaded area); CP, central pit; DMR, distal marginal ridge; DP, distal pit; CDG, central developmental groove; MP, mesial pit; MMR, mesial marginal ridge, (lower)

plimantal grooves join the terminal of the central groove in the mesial and distal triangular fossae.

Pulp cavity

In buccolingual section the pulp chamber is wide with prominent pulp horns. Some times the pulp chamber is quite deep with the floor extending well down. The mesial root may show broad root canal (but very thin mesiodistally) which becomes narrow at the apical end of the root to a pointed apical foramen. More likely this root presents two separate canals which join in a common apical opening, or the two canals open in two separated apical foramina.

In mesiodistal section the pulp chamber is wide and accommodate pulp horns. The mesial root shows considerable curvature which contains the most constricted canal mesiodistally. The distal root presents shorter, rounder and more open root canal.

In cross section at the cervical part of the pulp chamber is rectangular in shape.

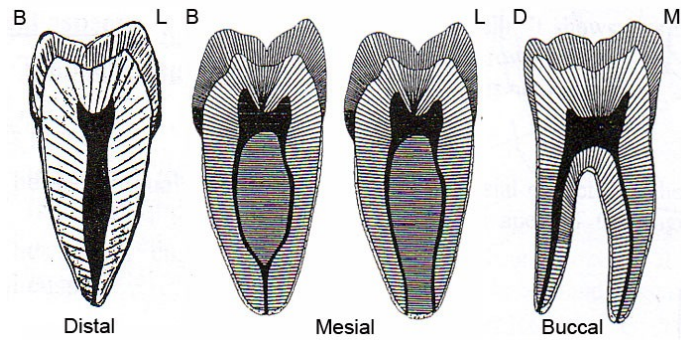


Fig. 48. Characteristics of pulp cavity of lower first molar.

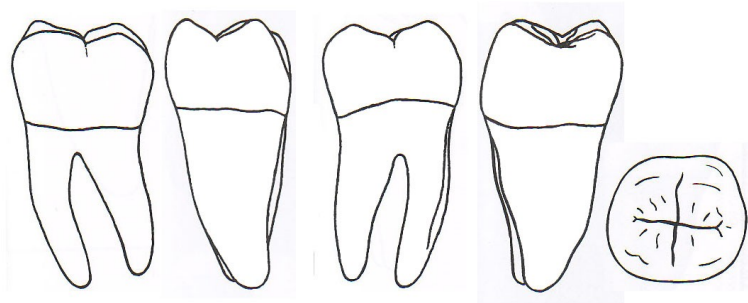


Fig. 49. Surface characteristics of mandibular left second molar. From left-to-right buccal, mesial, lingual, distal and occlusal aspects.

Mandibular Second Molar

The Second molar supplements the first molar in function and its anatomy differs in the following details.

- The second molar is slightly smaller than the first molar in all dimensions, although a second molar with larger crown or longer root may be found.
- The crown has four well developed cusps, two buccal and two lingual of nearly equal development. The distobuccal cusp is larger than the same one of the first molar.
- The tooth has two well developed roots, one mesial and distal. They are less wide buccolingually than the roots of the first molar and they are not so widely separated.

The differences between the second and first molars are as follow:-

■ Buccal aspect

- The crown is somewhat shorter cervico-occlusally and narrower mesiodistally than the first molar.
- The buccal cervical ridge is less prominent.
- There is one development groove, the buccal developmental groove between the mesiobuccal and distobuccal cusps.

Table XXI. Chronology of maxillary second molar

Dental Organ	Appearance	1Y
Start Calcification	2.5-3 Y	
Enamel Completed	7-8 Y	
Eruption	11-13 Y	
Root Completed	14-15 Y	

- The roots may be shorter and closer together and their axes are parallel. They are inclined distally in relation to the occlusal plane of the crown than is found on the first molar. The roots may be used for all or part of their length.

■ Lingual aspect.

- The crown and root of the second molar converge far less lingually than the first molar.
- The two lingual cusps, mesiolingual and distolingual are nearly the same size.
- The lingual developmental groove crosses from the occlusal surface onto the lingual surface and fades out near the junction of the middle and occlusal thirds, between the lingual cusps.
- The curvatures of the contact area are more noticeable from the lingual aspect. They are at slight lower level specially the distal

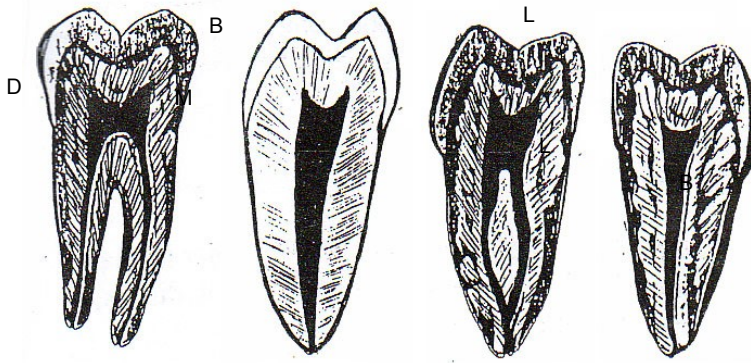


Fig. 50. Characteristics of pulp cavity of lower second molar. From left-to-right buccal, mesial, mesial variation and distal sections

contact area than those of the first molar.

- The cervical line is irregular mesiodistally.

■ Mesial aspect

- It is Rhomboidal in shape with lingual tilt.
- The buccal cervical ridge is less pronounced.
- The occlusal surface is more constricted buccolingually.
- The mesial root is less broad and somewhat pointed apically.

■ Distal aspect

- There is no distal cusp and distobuccal groove.
- The distal root is less broad.
- The contact area is therefore centered on the distal surface buccolingually as well as cervico-occlusally.

■ Occlusal aspect

- The occlusal aspect of the second molar differs considerably from the first molar. The outline form of the occlusal surface is rectangular wider mesiodistally than buccolingually.
- The second molar exhibit more curvature of the outline of the crown distally than mesially showing a semicircular outline of the

disto-occlusal surface in comparison with a square outline mesially.

- The occlusal surface shows four cusps. The distobuccal cusp is less pronounced than the mesiobuccal cusp. There is no distobuccal developmental groove buccally or occlusally. The distal cusp is absent. The lingual cusps are equal.
- The buccal and lingual development grooves meet the central groove at right angles at the central pit, so forming a cross dividing the crown into four nearly equal parts. This groove is known as **crossi form fissure**.
- There are major central fossa and two minor fossae (the mesial and distal triangular fossae). Three pits are present, a mesial a distal, and a central.
- There are more secondary grooves than on the first molar so the occlusal surface is wrinkled.
- **Pulp cavity.**
 - As for the mandibular first molar, except that the root canals appeared shorter, straighter with less spread.
 - The cervical cross section is not as square as the first molar as the crown tapers distally in the second molar.



Fig. 51. Surface characteristics of mandibular right third molar. From left-to-right buccal, mesial lingual, distal and occlusal aspects.

Mandibular Third Molar

The mandibular third molars are extremely variable in size and shape of both crown and root portions.

There are two basic forms:

- Type I resembles the permanent second molar 50%. It has four cusps and the same general occlusal pattern and contour. Ordinarily the size is the same, but range from very small larger than any other molar.
- Type II resembles the permanent first molar (40%) with five cusps and a similar occlusal pattern and contours. In 10% of cases it has more than five or less than four cusps.

The roots are extremely variable in size, number and curvature. Single fused roots are common. Most often, root length is less than other mandibular molars regardless of the crown size. The most common root form reveals two short curved roots.

Pulp cavity.

If it is well developed and is comparable to the second molar in shape the pulp cavity will resemble the second molar. However, if it differs, it follows the general outline of the tooth.



POLYPHYODONT

A **polyphyodont** is an animal whose **teeth** are continuously replaced. Most toothed fishes are polyphyodonts.

Sharks replace teeth throughout their life. They have teeth arranged in rows. When a tooth is lost it is replaced by the one next to it. Sharks may have 35000 to 50000 tooth in lifetime.

Reptiles and most other vertebrates are also polyphyodonts, but very few mammals are polyphyodont.

DESCRIPTION OF THE DECIDUOUS DENTITION

The deciduous teeth or primary, milk, baby and temporary teeth are twenty in number, 10 in each jaw (4 incisors, 2 canines and 4 molars).

They start to erupt at the age of six months by the appearance of the first deciduous mandibular incisors in the oral cavity. At about 2 years old, the last deciduous tooth which is the second molar, starts to appear. At three years of age all the deciduous teeth are erupted and are in function.

As the term “deciduous” implies, teeth are shed in order to make way for their permanent successors. The process of exfoliation takes place between the sixth and twelfth years. One to two years after complete root formation resorption begins at the root apex of the deciduous teeth and continues cervical until resorption of the entire root has taken place and the crown is lost from lack of support.

The anterior deciduous teeth are replaced by the anterior permanent teeth, while the deciduous molars are replaced by the permanent premolars.

The life span of all the deciduous teeth in the oral cavity are from 6 months to 12 years of age, therefore, from 6 months to 6 years the oral cavity contains only deciduous teeth.

From 6-12 years, the oral cavity contains mixed dentition (deciduous and permanent). From 12 years on, the oral cavity contains only permanent teeth.

Deciduous Anterior Teeth

Maxillary central incisor

The deciduous central incisor closely resembles its permanent successor except for the following:-

- It is smaller than the permanent.
- Its crown shows greater mesiodistal width than the cervico incisal length which is the opposite for the permanent. The labiolingual dimension at the cervical third is only 1mm. less than cervicoincisally.
- The lingual surface shows well developed marginal ridges and cingulum.
- The cervical ridges of enamel are pronounced on the cervical third of the crown both labially and lingually.
- From the proximal aspect, the crown appears thick in relation to its total length.
- From the incisal aspect, the crown appears much wider mesiodistally than labiolingually.
- The root length is greater in comparison with the crown length than that of the permanent. A lingual ridge is evident on the full length of the root. On the mesal and distal surfaces of the root, there are central development depression for about the whole length of the root.

Maxillary lateral incisor

It is similar to the central incisor with some variation.

- The crown is smaller in all dimension.
- The cervico-incisal length of the crown is greater than its mesiodistal width.
- The root is similar in shape to the central incisor but it is much longer in proportion to its crown.

Mandibular central incisor

They are similar to their successors except that:

- They are much smaller.
- The crown is wide in proportion to its length in comparison with the permanent.
- The mesial and distal sides of the crown taper evenly from the contact areas.
- From the mesial aspect, the incisal ridge is centered over the root. The labial and lingual cervical contours are quite convex, much more than those of the permanent mandibular incisors.
- The root is almost twice the crown length and evenly tapered down to a pointed apex. It is very narrow and conical in shape.

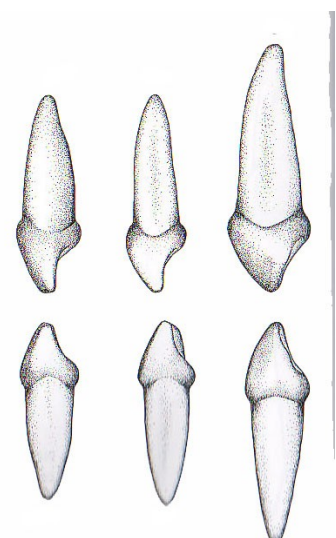
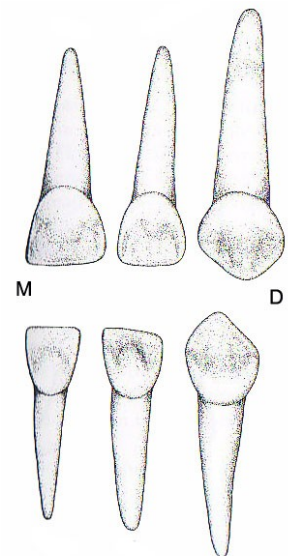
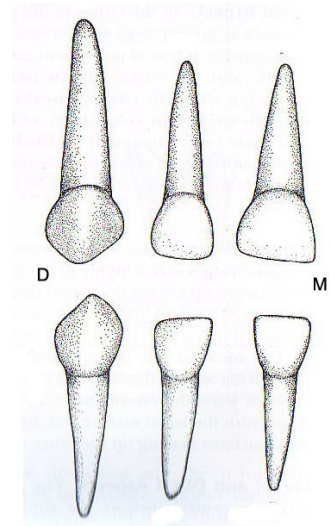


Fig. 52. Surface characteristics of primary maxillary and mandibular anterior teeth. Lingual aspect (upper), lingual aspect (middle) and mesial aspect lower.

- From the incisal aspect the incisal ridge bisects the crown labiolingually unlike permanent mandibular central incisors.

Mandibular lateral incisor

The fundamental outlines of the deciduous mandibular lateral incisors are similar to those of the deciduous mandibular central incisors except for:-

- It is somewhat larger in all measurements except labiolingually where the two teeth are identical in measurement.
- The cingulum, marginal ridges and lingual fossa are more developed.
- The incisal ridge slopes downwards distally, and its distal margin is more rounded.

Maxillary canine

It is similar to the permanent maxillary canine except for:-

- It is small in size.
- The crown is more constricted at the cervix in relation to its mesiodistal width and more convex on its mesial distal surfaces.
- The contact areas are placed at about the same level nearly at the center of the crown.
- Cervico – incisally.
- The cusp of the deciduous canine is much longer and shaper than the permanent. The mesial slope of the cusp is longer than the distal slope which is the opposite for the permanent.
- The tip of the cusp is more distal in relation to a line bisecting the crown mesiodistally.
- The root is about twice as long as the crown and more slender than that of its permanent successor.

Mandibular canine

It is similar to the permanent mandibular canine except for;

- It is smaller.
- The mesial slope of the cusp is shorter than the distal slope. This is true for both the permanent canines and premolars except the maxillary first premolar.
- It differs from the deciduous maxillary canine in the following:
 - It is thicker at the neck of the tooth.
 - The cervical ridge labially and the cingulum lingually are not quite pronounced.
 - The mesial cusp slope is shorter than the distal cusp slope.

Deciduous Posterior Teeth

Maxillary first molar

This tooth presents four cusps mostly and three roots. The mesiolingual cusp is the largest and the distolingual cusp is the smallest which may be even absent resulting in a three cusped molar. The first molar is much smaller than the deciduous maxillary second molar.

Buccal aspect

- It presents narrow cervical portion of crown and root than that of the same portion of the permanent molars.
- At the contact areas mesially and distally, the crown shows its widest measurements. The measurement at the cervix is less than that at the contact areas mesiodistally by about 2mm.
- The occlusal margin is slightly scalloped, but with no definite cusp form.
- The buccal surface is smooth with a slight evidence of developmental grooves.
- The furcation of the roots begins almost immediately at the site of cervical line. This characteristic is not possessed by the permanent molars.
- The roots are slender and long and spread widely. All three roots are seen from this aspect. The mesial root is longer than the distal one. Each of the three roots has a single root canal.
- The buccal cervical ridge is very developed particularly mesially.

Lingual aspect

- The crown converges considerably in a lingual direction.
- The outline lingually is similar to the buccal aspect.
- The mesiolingual cusp is the longest and sharpest, while the distolingual cusp is poorly defined or even absent. The distobuccal cusp may be seen from this aspect.
- All three roots are in view and the lingual one is the longest.

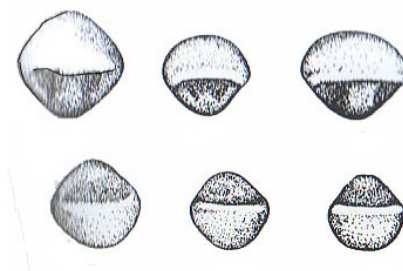


Fig. 53. Surface characteristics of primary anterior teeth, incisal aspect.

Mesial aspect

- The buccolingual dimension of the crown at the cervical third is greater than the same dimension at the occlusal third. This characteristic is true of all molar teeth, but it is more evident on the deciduous teeth (the crown is constricted at the occlusal third).
- The pronounced convexity of the buccal cervical ridge is an outstanding characteristic of this tooth.
- The mesiolingual cusp is sharper and longer in size than the mesiobuccal cusp.
- The cervical line is curved slightly toward the occlusal surface.
- The mesiobuccal and lingual roots are the only visible from this aspect. The root is long, slender and extends lingually to a marked degree then curves sharply in a buccal direction above the middle third.

Distal aspect

- The crown appears narrower distally than mesially.
- The distobuccal cusp is long and sharp, while the distolingual cusp is poorly developed.
- The buccal cervical ridge seen from the mesial aspect does not continue distally.
- The cervical line may curve occlusally or may run straight.
- The distobuccal and lingual roots are seen from this aspect as well as the apical part of the mesiobuccal root.

Occlusal aspect

- It is nearly rectangular in shape with the shortest sides representing the proximal sides (mesial and distal).
- The crown outline converges lingual and distally.
- The occlusal surface shows a sulcus with its central groove connecting a central fossa and a mesial triangular fossa.
- A distal development groove connects the central fossa and the distal triangular fossa.
- The mesial and distal triangular fossae are just inside the mesial and distal marginal ridges with a mesial and distal pit in them.

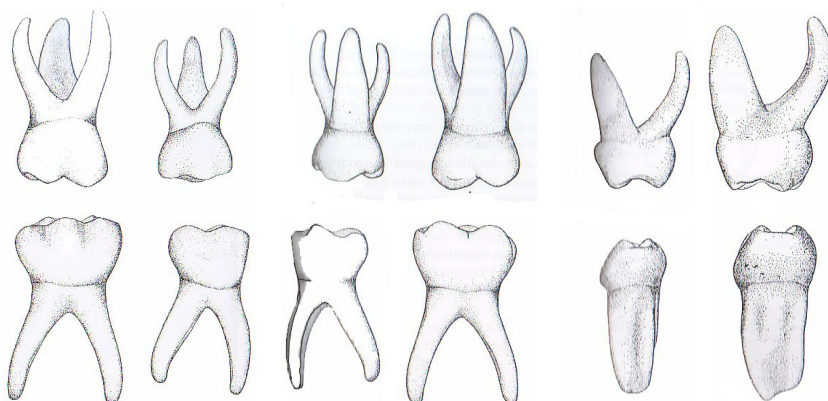


Fig. 54. Surface characteristics of primary molars, buccal aspect (left), lingual aspect

- Supplimental grooves radiate from the mesial and distal pits, one to abuccal, and one to a lingual directions. A third supplemental groove extends from the pit toward the marginal ridge and may extend over it.
- This tooth may show an oblique ridge connecting the mesiolingual and distobuccal cusps. This ridge may be ill defined and the central developmental groove extends from the mesial pit to the distal developmental groove.
- The distal marginal ridge is thin and poorly developed in comparison with the mesial marginal ridge.
- There is a well defined buccal developmental groove dividing the mesio buccal and distobuccal cusp occlusally.

Maxillary second molar

It resembles the maxillary first permanent molar that it is smaller in size.

Buccal aspect

- This tooth shows well defined buccal cusp separated by a buccal developmental groove.
- The crown is narrower at the cervix in comparison with its mesiodistal measurement at the contact areas.
- The roots appear slender and much longer and heavier relatively than those of the permanent maxillary first molar.
- The bifurcation of the roots is close to the cervical line.

Lingual aspect

- There is lingual convergence of the crown and root.
- It shows two well developed cusps, the mesiolingual and the distolingual cusps are separated by a short lingual developmental groove.
- A supplemental poorly developed to the large mesiolingual cusps and is outlined by developmental groove lingually.
- The cervical line is nearly straight.

- All three roots are visible from this aspect; the lingual root is larger and thicker than the two buccal roots.

Mesial aspect

- The outline resembles that of the permanent molars.
- The crown appears short because of its thickness buccolingually in comparison with its length.
- The mesiolingual cusp is larger than the mesiobuccal cusp.
- The lingual root extends lingually beyond the crown outline. The point of bifurcation between the mesiobuccal and lingual roots is 2-3mm. Apical to the cervical line.
- The curvature at the cervical portion is pronounced lingually, but it resembles that of the permanent maxillary first molar buccally. In this, it differs entirely from the prominent curvature found on the deciduous maxillary first molar at the cervical third buccally.

Distal aspect

It resembles that of the permanent maxillary first molar.

Occlusal aspect

- It is somewhat rhomboidal and resembles the permanent maxillary first molar except that the buccal surface is rather flat.
- The developmental grooves between the cusps are less marked than that found on the permanent molar.

Mandibular first molar

It varies much from all the teeth and appears strange and primitive. It possesses four cusps and two roots.

Buccal aspect

- It shows two cusps separated by developmental depression instead of groove. The mesiobuccal cusp is larger than the distobuccal cusp.

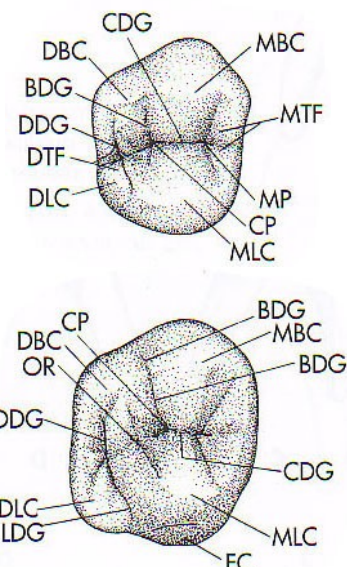


Fig. 55. Maxillary primary molars, characteristics of occlusal surface, first molar (upper) and second molar (lower). MPC, mesiobuccal cusp; MTF, mesial triangular fossa; MP, mesial pit; CP, central pit; MLC, mesiolingual cusp; DLC, distolingual cusp; DTF, distal triangular fossa; DDG, distal developmental groove; BDG, buccal developmental groove; DBC, distobuccal cusp; CDG, central developmental groove; FC, fifth cusp; LDG, lingual developmental groove; OR, oblique ridge

- The mesial outline of the crown is straight from the convex contact area to the cervix constricting the crown very little at the cervix.
- The distal outline converges toward the contact area and extends distally to a marked degree.
- The distal portion of the crown is shorter than the mesial portion because of dipping of the cervical line apically over the mesial root.
- There is a cervical enamel buccally (buccal cervical ridge) which is over development mesially. This makes the cervical line dip downward in order to outline this ridge.
- The two roots are long, slender and they spread greatly at the apical third beyond the outline of the crown. The distal root is shorter than the mesial one and their bifurcation is very close to the cervical line.

Lingual aspect

- The crown and root converge lingually to a marked degree on the mesial surface, while the opposite is true distally.
- The mesiolingual cusp is long and sharp, while the distolingual cusp is rounded with a lingual developmental groove separating them.
- The mesial marginal ridge is well developed to the extent that it might almost be considered as another small cusp lingually.

- The crown length mesially and distally is nearly equal.
- The cervical line is nearly straight.

Mesial Aspect

- It is rhomboidal in outline.
- The buccal outline shows prominent convexity representing the cervical ridge, then it flattens to the cusp tip.
- The buccal cusp is placed over the root base while the lingual outline of the crown extends out lingually beyond the confines of the root base. This design places the cusps in a favourable position for proper occlusion with the upper molars.
- The mesiobuccal cusp and the mesiolingual cusp as well as the well developed mesial marginal ridge are seen.
- The cervical line extends upward in a buccolingual direction.
- The buccal and lingual outlines of the root drop straight down from the crown approximately parallel each other for over half the root length then taper at the apical third to a square end.
- A developmental depression is usually extends almost through the full length of the root.

Distal aspect

- The crown has an equal length buccally and lingually and the cervical line is straight.
- The distal cusps are shorter and less sharper than the mesial cusps.
- The distal marginal ridge is less developed than the mesial marginal ridge.
- There is less curvature at the cervical third (no prominent buccal cervical ridge).
- The distal root is rounder, shorter and taper more apically.

Occlusal aspect.

- It is rhomboidal in outline.
- All four cusps are seen, the mesiolingual cusp is the largest.
- The prominence mesiobuccally (C.R) is noticeable from this aspect.
- From a central pit, the following grooves are seen,
 - A buccal developmental groove extends buccally separating the two buccal cusps. It does not extend on the buccal surface.
 - A central developmental groove extends mesially ending in mesial pit in the mesial triangular fossa and extends distally ending in a distal pit in the distal triangular fossa.
 - A lingual developmental groove extends lingually separating the two lingual cusps. It does not extend to the lingual surface.
 - There are supplemental grooves radiating from the mesial and distal pits buccally and lingually.

Mandibular second molar

It resembles the permanent mandibular first molar except for the following.

- It is smaller in size.
- The deciduous molar presents narrow mesiodistal cleftation at the cervix than does the permanent molar.
- The mesiobuccal and distobuccal developmental grooves divide the buccal surface of the crown occlusally into three cuspal portions almost equal in size (mesiobuccal and distobuccal and distal cusps).
- The mesial portion of the crown seems to be little higher than the distal portion of the crown lingually which gives the impression of being tipped distally.
- There is a prominent buccal cervical ridge, then the buccal surface flattened occlusal to the ridge.
- Proximally, the crown is rhomboidal in outline.
- The mesial marginal ridge is high, while the distal marginal ridge dips down more sharply and is shorter buccolingually than the mesial marginal ridge.
- The crown is narrower buccolingually in comparison with its mesiodistal measurement than is the permanent tooth.
- The root flares out greatly mesiodistally at the middle and apical thirds. They are twice as long as the crown. Their bifurcation starts at a point immediately below the cervical line.
- The roots are more slender than those of the permanent molars.
- The occlusal surface shows a rectangular outline that converges lingually and distally.

The major differences between the deciduous and permanent teeth

- The crowns of the deciduous teeth are lighter in color than are the permanent teeth.
- The deciduous teeth are smaller in size than the permanent.
- The crowns of the deciduous teeth are more bulbous.
- The crowns of the deciduous anterior teeth are wider mesiodistally in comparison with their crown length than are the permanent.
- The crown widths of the deciduous molars are larger in all directions in comparison with the root trunks and cervixes. The crown and roots are slender at the "neck" mesiodistally than are those of permanent molars.
- The buccal and lingual surfaces of deciduous molars taper occlusally above the cervical curvature much more than do the permanent molar

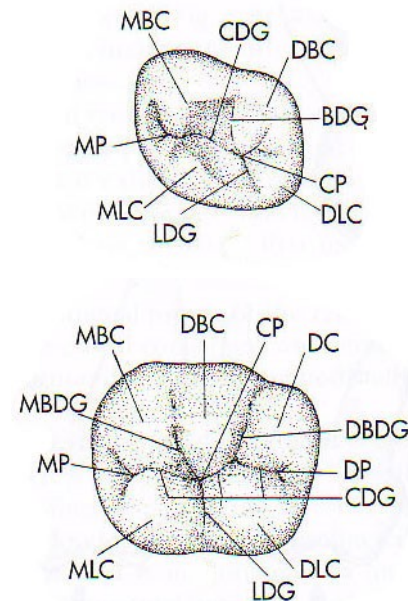


Fig. 56. Mandibular primary molars, characteristics of occlusal surface, first molar (upper) and second molar (lower). MBC, mesiobuccal cusp; CDG, central developmental groove; DBC, distobuccal cusp, BDG, buccal developmental groove, CP, central pit; DLC, distolingual cusp; LDG, lingual developmental groove; MLC, mesiolingual cusp; MP, mesial pit; MBC, mesiobuccal cusp; DBCG, distobuccal developmental groove; DP, distal pit; MBDG, mesiobuccal developmental groove; DC, distal cusp.

surfaces. This results in a much narrower occlusal table of the occlusal surface buccolingually.

- The buccal cervical ridge of enamel is quite prominent on the facial aspect of the deciduous anterior and molar teeth (especially on the first molars).
- The roots of the deciduous anterior teeth are narrower and longer in comparison with crown length, as well as tooth length and width, than are the permanent teeth roots.
- The roots of the deciduous molars are relatively longer and more slender than the roots of the permanent teeth. They are more divergent and flare more extending out beyond projected outlines of the crown. The roots thin out rapidly as the apices are approached.
- In cross section, the deciduous teeth shows the following differences:
 - The enamel is relatively thin and has a consistent depth.
 - The dentin thickness between the pulp chamber and the enamel is much less than in the permanent teeth.
 - The pulp chambers are relatively large, and the pulp horns are high occlusally placing them much closer to enamel than the permanent teeth.