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Paper: Comparative anatomy of Vertebrates

UNIT -2
TOPIC: Dentition in Mammals

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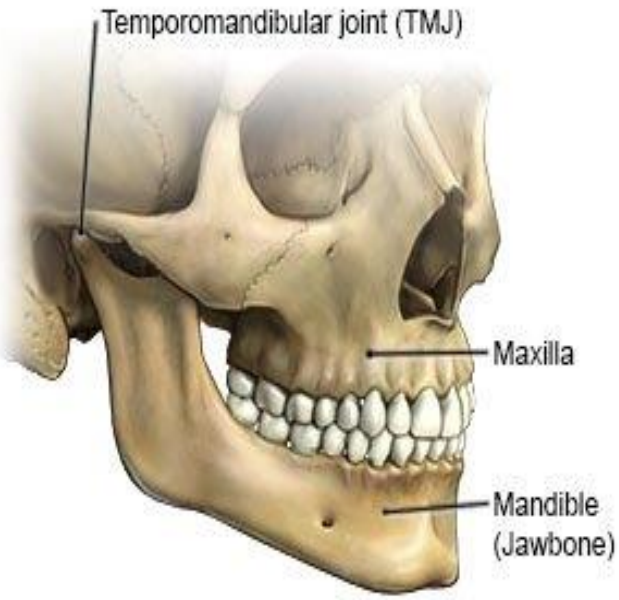
DENTITION

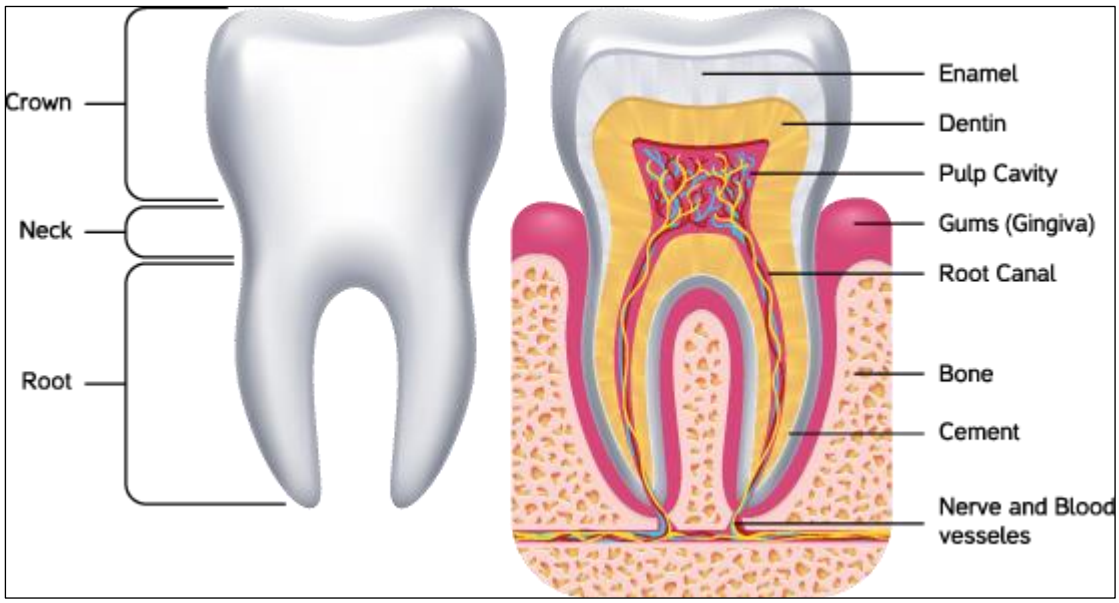
The **hard and usually pointed structures connected to the jaw bones in the buccal cavity of vertebrates** are known as **teeth** that are variously modified to tear, cut or grind food material before it is **swallowed.**

The arrangement-- structure and number of types of teeth in the upper and lower jaw is collectively **called dentition**. Although teeth are found among fishes, amphibians and reptiles and are also known to have been present in ancestral birds, but they are most **highly specialised in mammals.**



Jaw

Epidermal teeth are hard cornified epidermal structures of rare occurrence, as in the buccal funnel of **cyclostomes and in turtles and birds**. **Dermal teeth or true teeth** are found in most of the vertebrates. Teeth are as a rule **present in the foetal as well as adult conditions of mammals**. They are present on the maxillae and mandibles.



STRUCTURE OF HUMAN TOOTH (MAMMAL)

A human tooth has an external structure (crown, neck, and root) and an internal structure (enamel, dentin, and pulp).

External Structure:

- **Crown:** The portion of the tooth above the gum line, visible in the mouth.
- **Neck:** The area where the crown meets the root, located at the gum line.
- **Root:** The part of the tooth embedded in the jawbone, anchoring the tooth in place and not visible externally.

Internal Structure:

- **Enamel:**

The outermost **layer of the tooth, covering the crown is the enamel.** It is whitish, shiny and the hardest substance in the body-secreted by Ameoloblast or enameroblast cell. Enamel is made up of inorganic materials -Calcium carbonate and calcium phosphate. They are resistant to decay.

- **Dentin:**

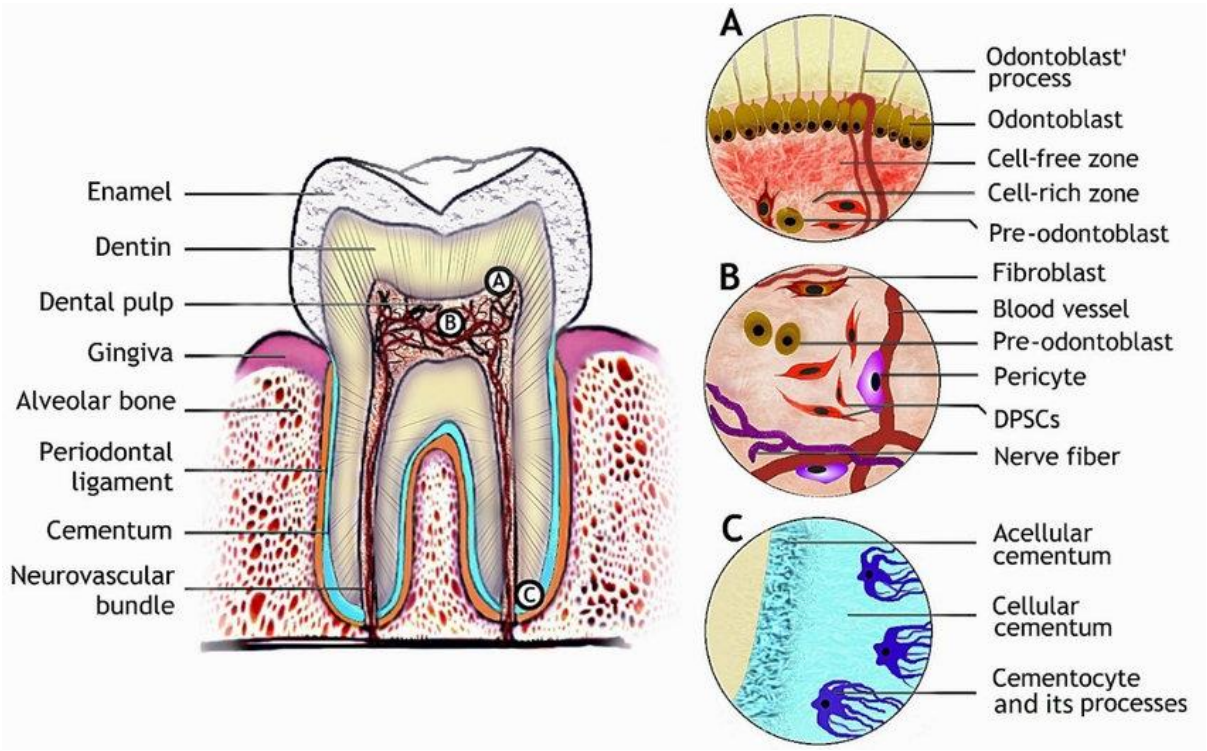
A layer beneath the enamel, **forming the main part** of the teeth. It extends almost the entire length of the tooth, being covered by enamel on the crown portion and by cementum on the roots. It is secreted by **odontoblast cells** and consists **of 62-69% inorganic substances**. **It contains microscopic tubes** and less hard than enamel.

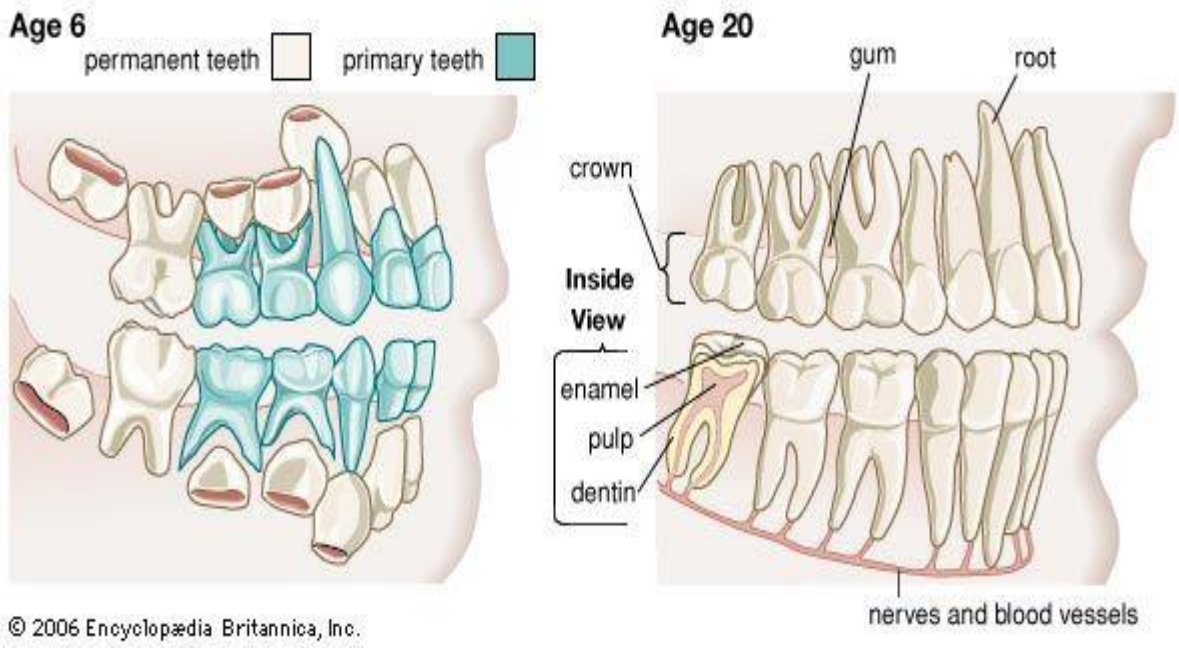
- **Pulp chamber**

The innermost layer is the pulp cavity lined by odontoblast cells. It consists of cells, tiny blood vessels, and a nerve-- crucial for the tooth's health and sensitivity. It occupies a cavity located in the centre of the tooth called pulp cavity. **Pulp cavity give rise to root canal.** The pulp canal is long and narrow The pulp canal extends almost the whole length of the tooth and communicates with the body's general nutritional and nervous systems through the apical foramina (holes) at the end of the roots

- **Cementum:**

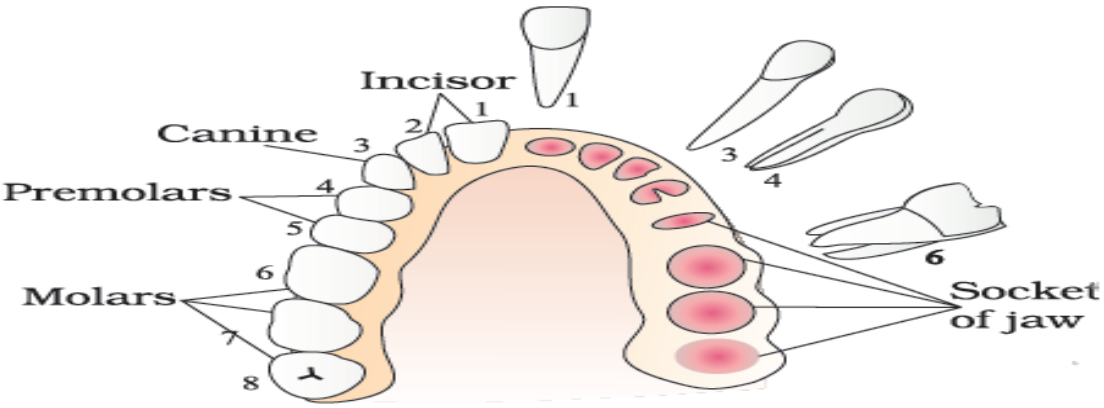
Below the gumline extends the root of the tooth, which is covered at least partially by cementum. It is a layer of connective tissue that provides a thin covering to the root and serves as a medium for attachment of the Root to the jawbone called as alveolar bone via the periodontal ligament





Like most other mammals,
Humans have two successive sets of teeth during life. The first set of teeth are called primary, or deciduous, ones, and the second set are called permanent ones. Humans have 20 primary and 32 permanent teeth.
Primary teeth differ from permanent teeth in **being smaller, having more pointed cusps, being whiter and more prone to wear, and having relatively large pulp chambers and small, delicate roots.** The primary teeth begin to appear **about six months after birth**, and the primary dentition is complete **by age 2 1/2**; shedding begins about age **5 or 6 and is finished by age 13.** The primary teeth are shed when their roots are resorbed as the permanent teeth push toward the mouth cavity in the course of their growth.

In humans the **primary dentition consists of 20 teeth**— four incisors, two canines, and four molars in each jaw. The primary molars are replaced in the adult dentition by the premolars, or bicuspid teeth. The 12 adult molars of the permanent dentition erupt (emerge from the gums) behind the primary teeth and do not replace any of these, giving a total of 32 teeth in the permanent dentition. The permanent dentition is thus made up of four incisors, two canines, four premolars, and six molars in each jaw



TYPES OF DENTITIONS

Teeth can be classified on the basis of

1. **Mode of Attachment of Teeth**
2. **Succession or replacement of teeth**
3. **Differentiation (Shape) of teeth**

BASED ON MODE OF ATTACHMENT OF TEETH: The manner of attachment of teeth at their bases with the jaw bones varies throughout the vertebrates.

These are of the following three types:

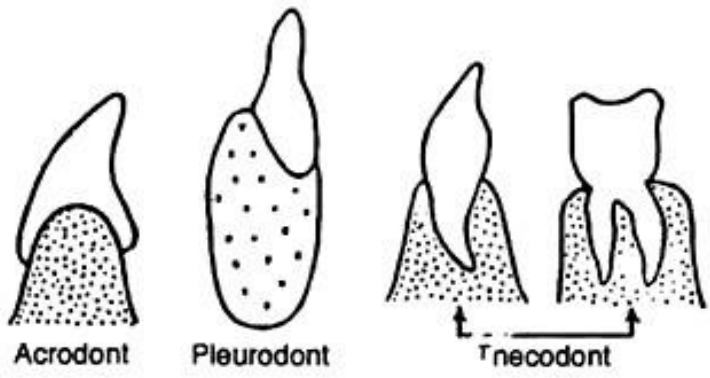


Fig. 2.32 : Mode of attachment of teeth

1. Acrodont Type: This condition occurs in most vertebrates in which **teeth are attached on the crest of jaw bone or attached to the free surface of the jaw bone**. Teeth have no roots. Such teeth are apt to break off easily but are replaced. **Example: Fishes like shark or amphibians like frog and some reptiles like Draco, Uromastrix, Agama.**

2. Pleurodont Type: Teeth are attached to the shelf-like indentations on the inner margin of jaw bone by their bases as well as one side. Pleurodont teeth are also rootless, so that nerves and blood vessels enter the pulp cavity along lateral side at the base of the tooth. This condition occurs commonly in **Amphibia (urodels) and reptiles (lizards)-Ex**

3. Thecodont Type: In this type the teeth have roots (one or more) and the roots are embedded in sockets called alveoli or theca of jaw bones, a crown

projects above the socket. Since root of the tooth is firmly fixed in a socket of the jawbone, making the attachment strongest in vertebrates. **Ex:** Thecodont type of teeth is found in **some fishes like haddock, reptiles like crocodilians and mostly in mammals.**

BASED ON THEIR PERMANENCE OR REPLACEMENT (SUCCESSION), TEETH FALL INTO THREE CATEGORIES:

1. Polyphyodont 2. Diphyodont and 3. Monophyodont.

1. Polyphyodont:

Polyphyodont dentition involves replacement of teeth from time-to-time ie., several times in lifetime so that jaws are never left without teeth. Lower vertebrates having loose attachment of teeth, lose teeth while feeding and capturing prey and hence teeth must grow again to replace the lost ones. **Ex: Occurs in most of the lower vertebrates such as Dogfish and many reptiles such as crocodiles and geckos.**

2. Diphyodont:

In this condition, teeth develop during life in **two successive sets**. This condition is known as diphyodont. **Teeth of the first set are called deciduous, lacteal or milk teeth.** They usually erupt after birth and later, milk teeth are replaced in the adult by the permanent teeth which last throughout life. If again lost, they are not replaced. **Ex: most mammals such as human, bats, guinea pigs**, cape ant-eaters or aardvarks

3. Monophyodont:

Teeth appear only once in lifetime and if they fall, they are never again replaced by the new ones. **Ex:** Monophyodont condition is seen **in some mammals such as platypus, marsupials, moles, sirenians, cetaceans (toothless whales)** & **squirrels.**

BASED ON DIFFERENTIATION (SHAPE) & SIZE OF TEETH:

Morphologically, teeth can be distinguished into two types such as homodont and heterodont.

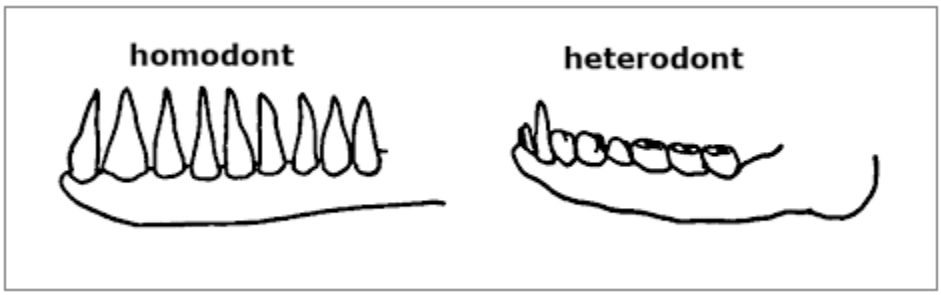


Fig showing homodont and heterodont teeth

1. Homodont Teeth:

Homodont dentition is a type of condition**, in which all teeth are similar or alike in shape and size**. The number of teeth in these homodont mammals varies between 2 and 200. **Ex:** Among mammals only certain cetaceans (**whales, dolphins, and porpoises**) have homodont dentition and also found in the majority of vertebrates such as fish amphibia and reptiles

2. Heterodont Teeth:

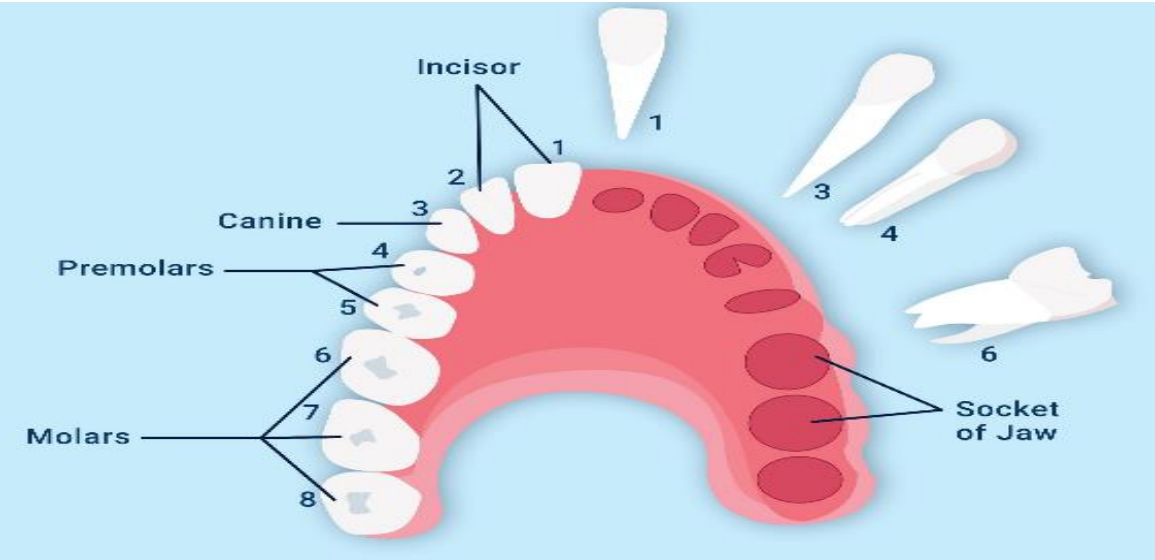
Mammalian teeth are characteristically heterodont, i.e., dissimilar in shape, size and functions. Function is also different at different parts of the tooth row. The differentiation depends upon the nature of food eaten and the manner of procuring or securing it.

Ex: Except mammals, heterodont condition is found in Port Jackson Shark, in several reptiles especially among mammal like reptiles.

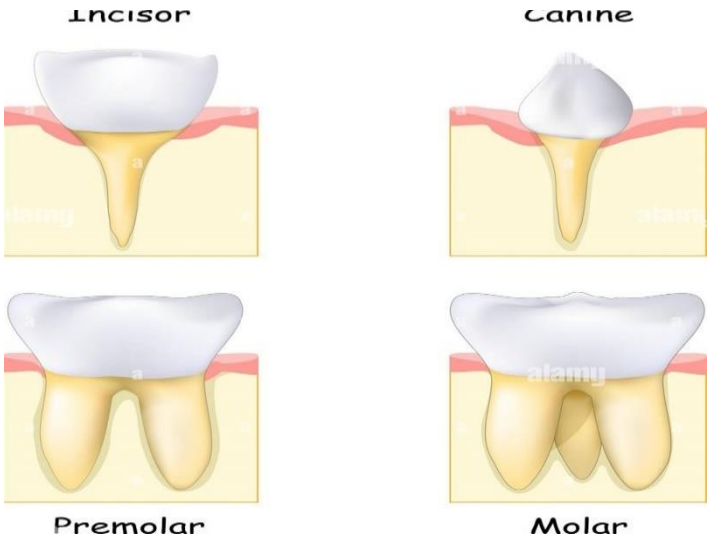
DENTITION IN MAMMALS

Not all mammals possess teeth. In some monotremes, Echidna and in some American ant- eaters, however, teeth are entirely absent at any time. In some spiny ant-eaters (Tachyglossus) no teeth are found in any stage. The true or great ant-eater (Myrmecophaga) also has no teeth.

In most mammals, thecodont, Diphyodont, heterodont teeth are found.



But in toothed whale and Dolphins, homodont teeth are found.



The heterodont dentition commonly includes four kinds of teeth such as incisors, canines, premolars and molars.

1. **Incisors** (cutting teeth) are **present in front of each jaw (anterior part of the Buccal cavity)** embedded in premaxillary bone in **upper jaw** and tips of dentaries in **lower jaw**. These are conical, Single crown (monocuspid) with single root present and used to cut and bit food.

In herbivorous mammals, incisors are best developed which use them for holding and cutting the food.

Variation of incisors in different animals:

- In **rodents and lagomorphs-** the incisors are chisel shaped, open rooted and continue to grow throughout life.
- In ox, incisors are absent in the upper jaw and in vampire bat they are absent in the lower jaw or may be completely absent in sloth.
- **Elephant and mastodon tusks are modified incisors** and grow throughout the life as in rodent incisors.
- In Lemurs, **the incisors are denticulate like a comb** which helps in cleaning of fur.

Fig: Lemur

Fig showing comb like Incisors

2. **Canines** (tearing teeth): A single canine is present in each half of each jaw. Generally elongated, monocuspid and single rooted. Crown is conical and sharp. They are used for piercing and tearing.
    - In carnivores **(dog),** canines become large, strong and pointed spear like for tearing flesh.
    - Canines are present only in upper jaw in **male musk deer,**
    - Upper canines form tusks **in walrus** for digging molluscs and for locomotion on ice.
    - In some herbivores mammals **like rabbit** canines are absent leaving a wide toothless space **called diastema**

Dentition of Rabbit
(Arrangement of teeth in jaws)

3. **Premolars**: Following the canines, there are premolars or bicuspids teeth. **Premolar** have two roots and two cusps or crown. They are used for grinding the food materials.
4. **Molars: It lies behind the premolars. They** have two or more than two roots and several crown. Molars are used for crushing the food.

Premolars and Molars are called Grinding or **check teeth**.

Located on the posterior part of the buccal cavity.

- **In some carnivores,** last upper premolar and first molar in lower jaw are modified into chisel shaped sharp cusps called carnassial used for cracking bones.
- **In lemurs**, first premolar is like canines.
- **In Human,** 3rd pair of molar ie., last molar is called wisdom teeth and its eruption is delayed or sometimes never erupts.

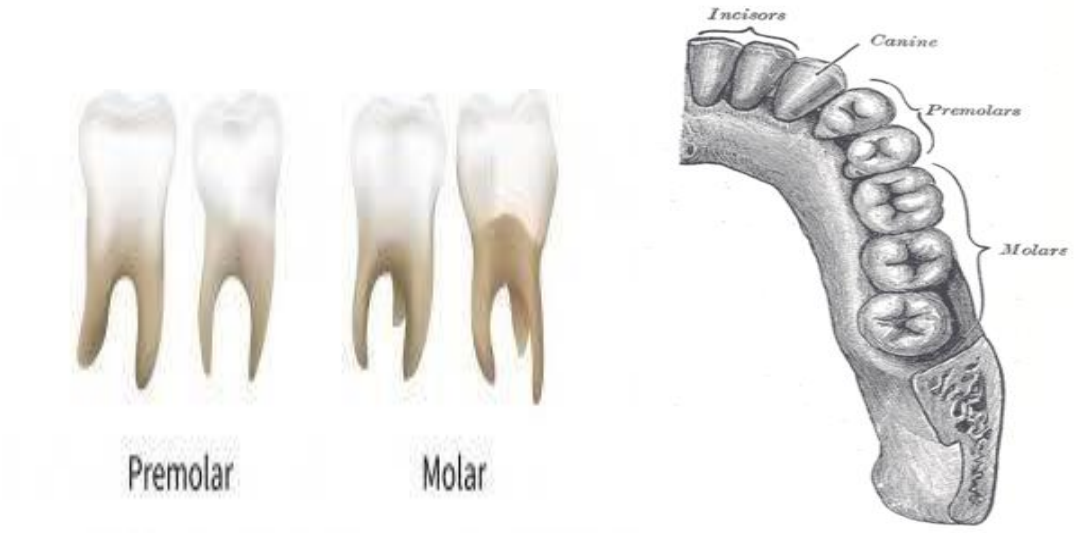


Fig showing premolar and molar teeth with cusps

Check teeth are of various types depending on the number, shape and arrangement of cusps

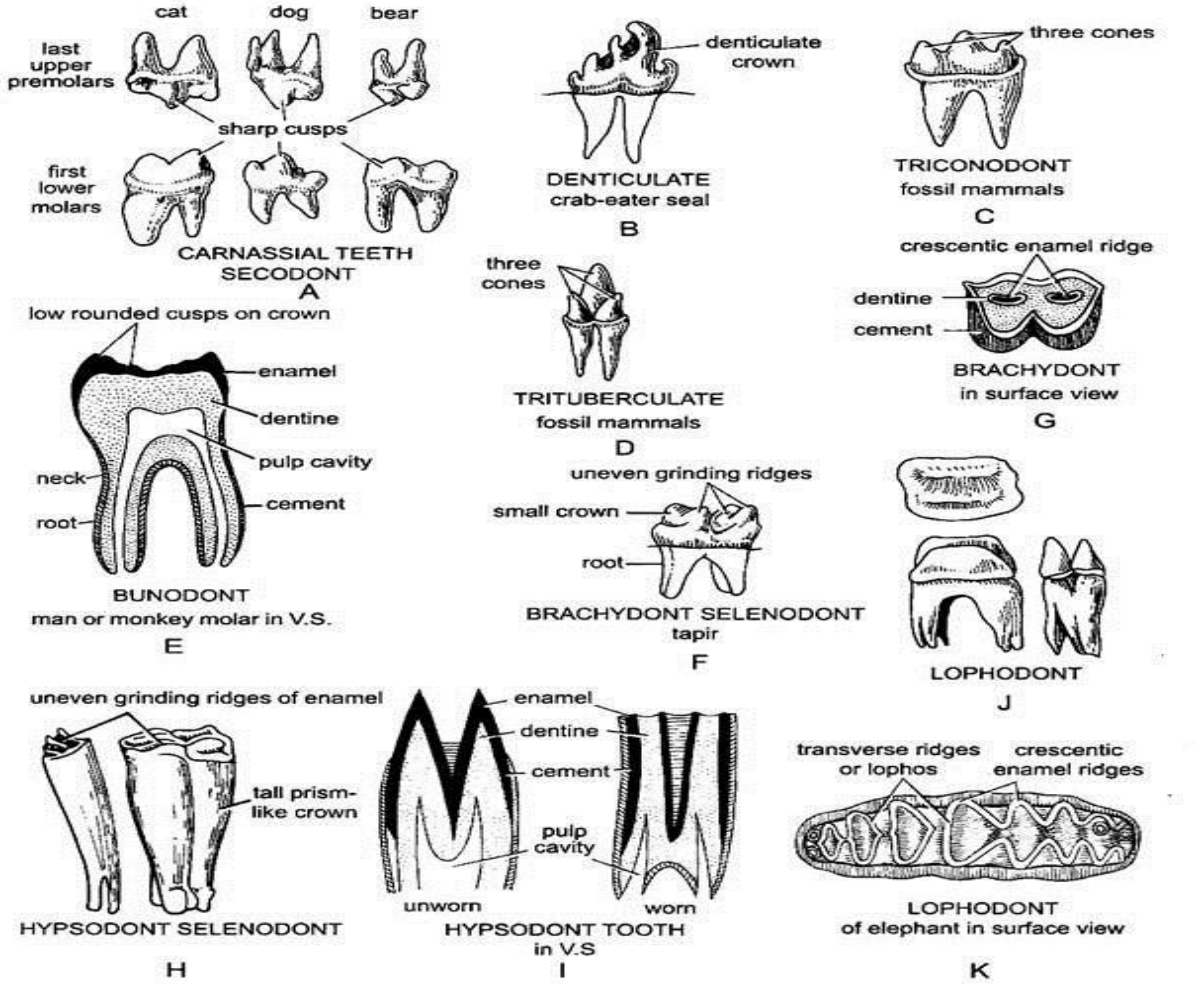


Fig. 33.4. Modifications of cheek teeth. A – Carnassial teeth (secodont); B – Denticulate molar; C – Triconodont tooth; D–Trituberculate tooth showing arragement of cusps; E–Bunodont molar in V.S. ; F–Brachydont selenodont molar; G–Surface view of crown of brachydont molar; H–Hypsodont selenodont molars; I–Hypsodont teeth in V.S.; J–Lophodont molar; K–Lophodont in surface view.

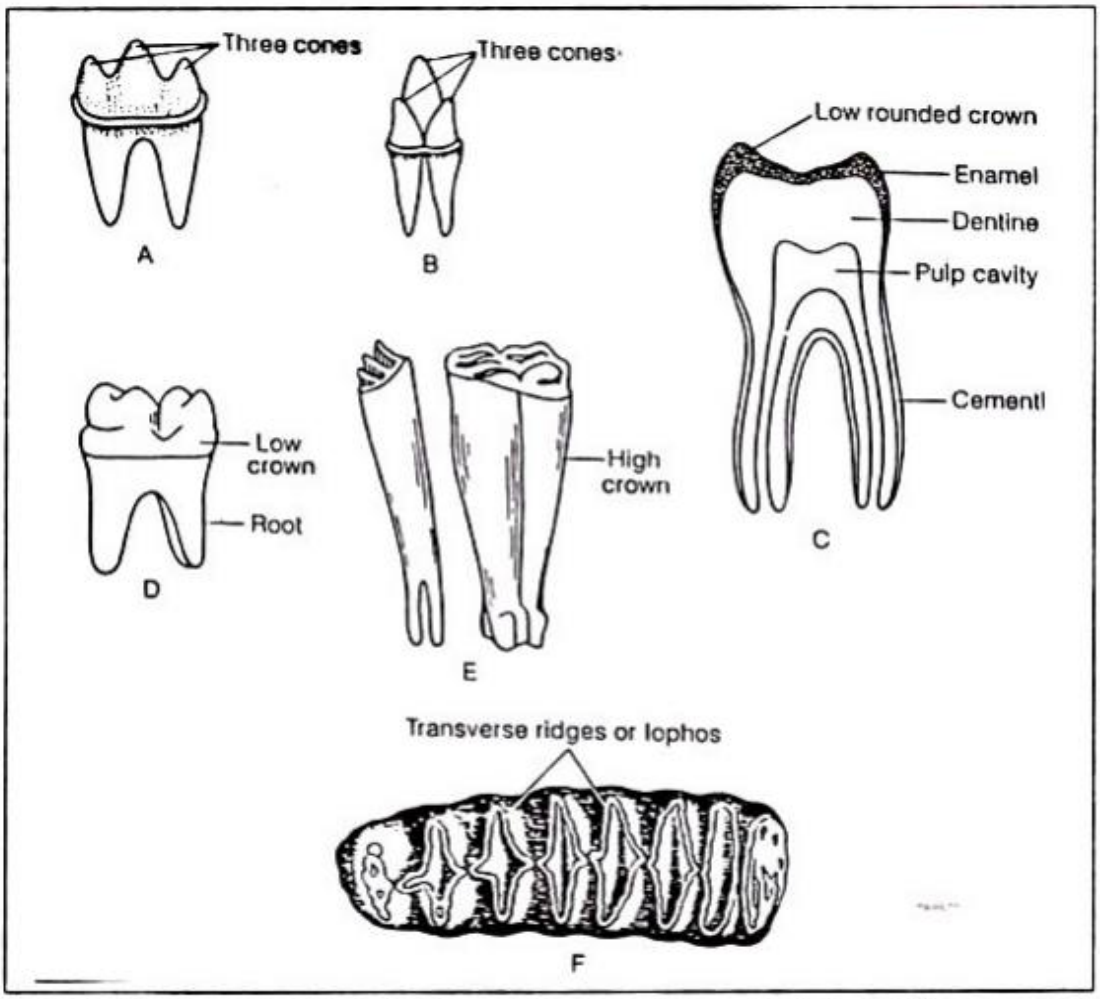
CUSPS PATTERNS OF CHEECK TEETHS

The molars contain many cusps on their surface. The cusps are raised tiny structures or ridges on the occlusal surface. The cusps are called cones.
Depending on the number and shape of the cusps, molars are recognised in different names.

[Among fossil mammals]

(i) **Triconodont:** In this condition molars possess 3 cones or cusps arranged in anteroposterior lines. This type of molar teeths are found in the fossil Mesozoic mammals e.g., Triconodon.

(ii) **Trituberculate:** Here the molars contain three cones or tubercles, arranged in the form of a triangle. It is also found among fossil Mesozoic mammals, e.g., Spalacotherium.



. 10.129 : Modifications of cheek teeth : A. Triconodont tooth. B. Trituberculate tooth. C. V.S. of a bunodont molar. D. Brachydont molar. E. Hypsodont molar. F. Lophodont teeth.

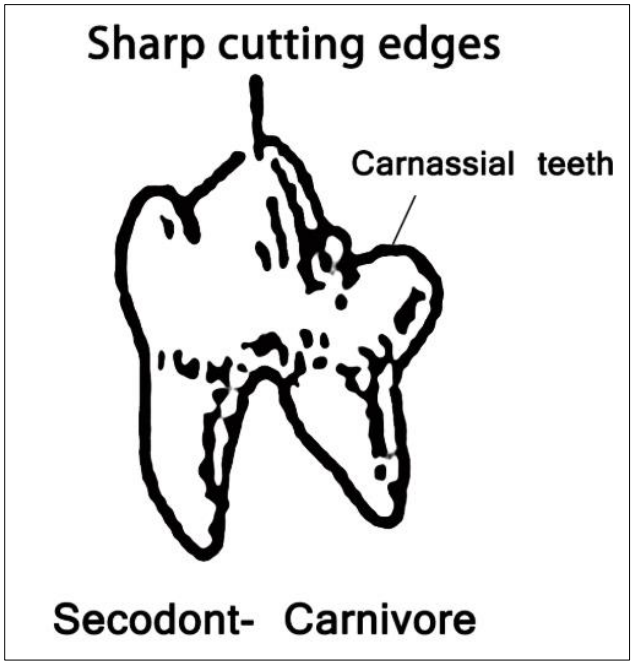
Depending upon the feeding habit and the type of food taken (trophic specialization), the premolars and molars of recent eutherians have undergone changes in their shape, and cheek teeth are recognised into the following names.

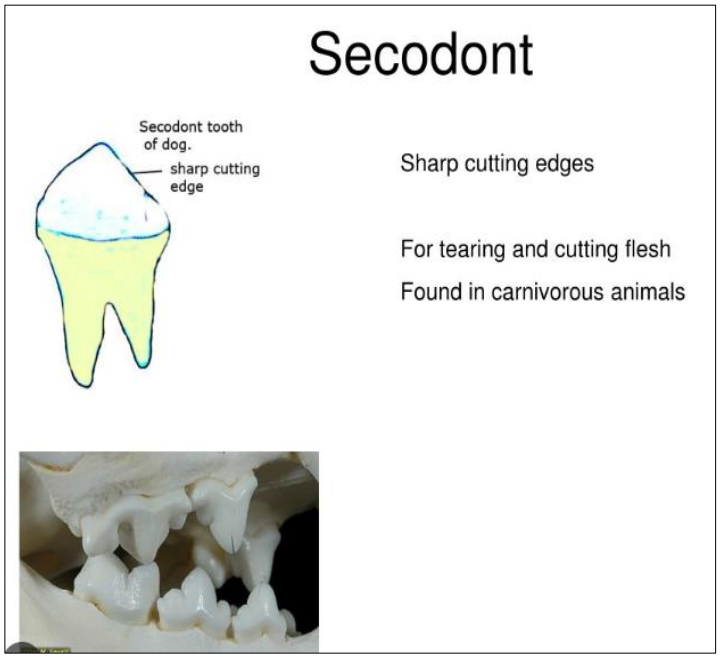
(i) **Bunodont:** When the cusps in the cheek teeth remain separate and rounded, the tooth is called bunodont. **In man and in some omnivore mammals** the cheek teeth are bunodont type and they are used in grinding the food material.

(ii) **Lophodont:** If the cusps are joined to form ridges or lophs, the tooth is called lophodont. The **cheek teeth of elephant are of lophodont type.** There is an intricate folding of enamel and dentine. These type of teeth are used to grind all sorts of plants, and also grasses.

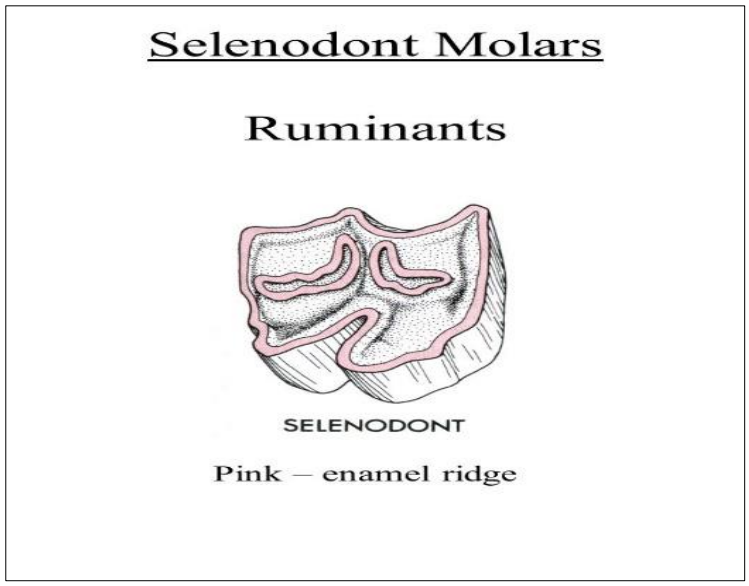
Fig showing lophodont teeth of elephant

(iii) **Secodont:** When the cheek teeth are with sharp cutting crowns, the teeth are called secodont. This condition of teeth is present in **terrestrial carnivores**. These teeth possess cutting edges and are used for cutting and shearing the flesh.



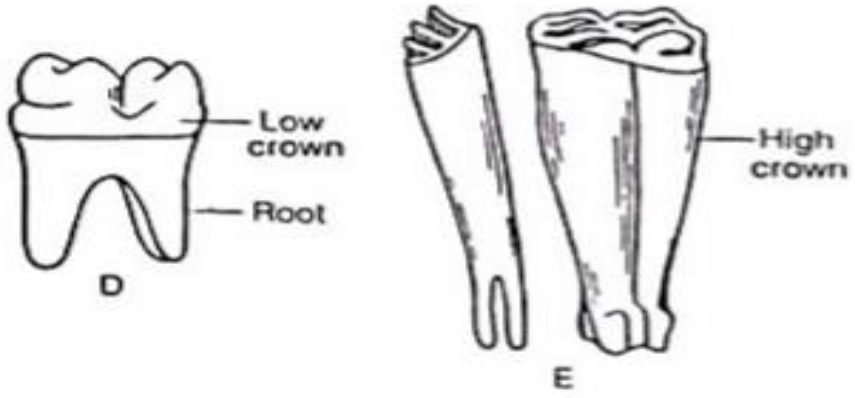


(iv) **Selenodont:** Cheek teeth with crescent-shaped cusps are known as selenodont. **In ruminants and horses**, the teeth are selenodont type and are used for grinding the plant matter.



(v) **Brachydont:** A tooth with a low crown and comparatively long root is called brachydont (short + tooth) **(Fig. D**), **e.g., Man.**

(vi) **Hypsodont**: When the crown is high and the roots are short and open **(Fig. E),** e.g., Horse, incisor of elephants.



Dental Formula: The formula showing the number and arrangement of the teeth in one half of each jaw (upper and lower jaw) is called dental formula.

In each set, incisors (I) are indicated first, canines (C) second, premolars (P) third, and finally molars (M), giving I:C:P:M. There are 20 milk (temporary) teeth.

Dental formula of the temporary or milk teeth is 2102/2102 = 10 x 2 = 20

Dental formula of adult man (mammal) is 2123/2123 = 16 x 2 = 32