






**Operative Dentistry.
Endodontics: in 2 volumes.
Volume 1: textbook**

КУПИТИ

The textbook covers the history of dentistry, considers the anatomical and histological structure of the teeth and oral mucosa, describes the restorative materials for caries cavities restoration and root canals obturation, methods of caries cavity preparation and restoration, and root canals obturation.  The textbook outlines basic examination methods of patients with hard dental tissue lesions: den-tal caries and its complications; the basic data of the most common human disease — dental caries, its main etiologic and development factors. The dental caries clinical features, diagnosis and differential diagnosis of caries with other similar diseases are described. The methods of dental caries treatment with the use of modern medicamental preparations and restorative materials are described.  The causes and mechanisms of dental pulp inflammation — pulpitis, its clinical features, the basic principles of diagnosis and treatment using modern methods of anesthesia are described.  The etiology, pathogenesis, clinical features of periodontal ligament inflammation — apical perio-dontitis are described. The basic methods of its treatment are presented.  Considerable attention is paid to typical dentist errors that happen during treatment of dental caries, pulpitis and apical periodontitis, their causes, methods of prevention and elimination are described.  The textbook is aimed at English-speaking students of stomatologic faculties of higher medical education establishments.

Operative Dentistry Endodontics

IN 2 VOLUMES

Edited by Professor **A.V. BORYSENKO**

Second edition

VOLUME

1

RECOMMENDED

by the Ministry of Health of Ukraine
as a textbook for students of higher
medical education establishments

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Authors:

*M.Yu. Antonenko, L.F. Sidelnikova, O.F. Nesyn, Zh.I. Rakhniy, I.H. Dikova, Yu.H. Kolenko,
O.V. Lynovytska, O.V. Kononova, A.G. Dimitrova*

Editor in chief:

A.V. Borysenko, Head of the Department of Therapeutic Dentistry of O.O. Bogomolets
National Medical University, Doctor of Medical Sciences, Professor

Reviewers:

K.M. Kosenko, Corresponding Member of the NAMS of Ukraine, Academician of the
UAS, Doctor of Medical Sciences, Professor; *Ye.V. Kovaliov*, Honored Worker of Sciences
and Engineering of Ukraine, Academician of the UAS, Doctor of Medical Sciences, Professor

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DENTAL ANATOMY

CHAPTER

2

Man has two generations of teeth, the deciduous or primary dentition and the permanent or secondary dentition. There are no teeth in the mouth at birth but by the age of 3 years the deciduous dentition is complete. Primary dentition consists of 20 teeth that begin to form during the first trimester of pregnancy. The teeth typically begin erupting around 6 months. Most children have a complete primary dentition by 3 years of age.

By 6 years, the first permanent teeth appear and thence the deciduous teeth are exfoliated one by one to be replaced by their permanent successors. It consists of 32 teeth in most cases. The teeth begin to erupt around 6 years of age and most permanent teeth are erupted by age 12. Third molars (wisdom teeth) are the exception; often they do not appear until late teens or early 20s.

A complete permanent dentition is present at or about the age of 18 years. Thus, given the average life of 70 years, the functional life span of the deciduous dentition is only 6 per cent of this total, while with care and luck it can be over 90 per cent for the permanent dentition. In the complete deciduous dentition there are 20 teeth — 10 in each jaw. In the complete permanent dentition there are 32 teeth — 16 in each jaw. In both dentitions, there are three basic tooth forms, incisiform, caniniform and molariform (Fig. 14). Incisiform teeth (incisors) are cutting teeth having thin, blade-like crowns. Caniniform teeth (canines) are piercing or tearing teeth, having a single, stout, pointed, cone-shaped crown. Molariform teeth (molars and premolars) are grinding teeth possessing a number of cusps on an otherwise flattened biting surface. Premolars are bicuspid teeth which are peculiar to the permanent dentition and which replace the deciduous molars.

The main dental supportive structures are: enamel (hard tissue), dentin (hard tissue), pulp (soft tissue), gingiva (soft tissue), periodontal ligament (soft tissue), cementum (hard tissue), alveolar bone (hard tissue) (Fig. 15). Every tooth has three main parts: anatomic crown, anatomic root and pulp chamber with root canals. **The anatomic crown** is the portion of the tooth covered by enamel. **The anatomic root** is the lower two

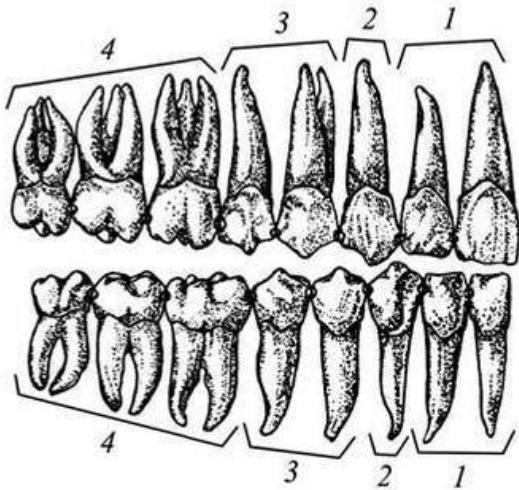


Fig. 14. Permanent dentition teeth: 1 — incisors; 2 — canines; 3 — premolars; 4 — molars

thirds of a tooth. The **pulp chamber** houses the dental pulp, an organ of myelinated and unmyelinated nerves, arteries, veins, lymph channels, connective tissue cells, and various other cells. The pulp in the crown of the tooth is known as the coronal pulp; in apical direction pulp traverse the root canals — radicular pulp (Fig. 16).

Incisors function as cutting or shearing instruments for food. **Canines** possess the longest roots of all teeth and are located at the corners of the dental arch. **Premolars** act like the canines in the tearing of food and are similar to molars in the grinding of food. **Molars** are located nearest the temporomandibular joint (TMJ), which serves as the fulcrum during function.

Every tooth has some edges and surfaces. **Apical**: Pertaining to the apex or root of the tooth. **Labial**: Pertaining to the lip; describes the front surface of anterior teeth. **Lingual**: Pertaining to the tongue; describes the back (interior) surface of all teeth. **Distal**: The surface of the tooth that is away from the median line. **Mesial**: The surface of the tooth that is toward the median.

Some terms used for the description of tooth form:

Crown: — Clinical crown — that portion of a tooth visible in the oral cavity. Anatomical crown — that portion of a tooth covered with enamel.

Root: — A clinical and anatomical root may be defined, the clinical root being that portion of a tooth which lies within the alveolus, the anatomical root being that portion of a tooth covered by cementum.

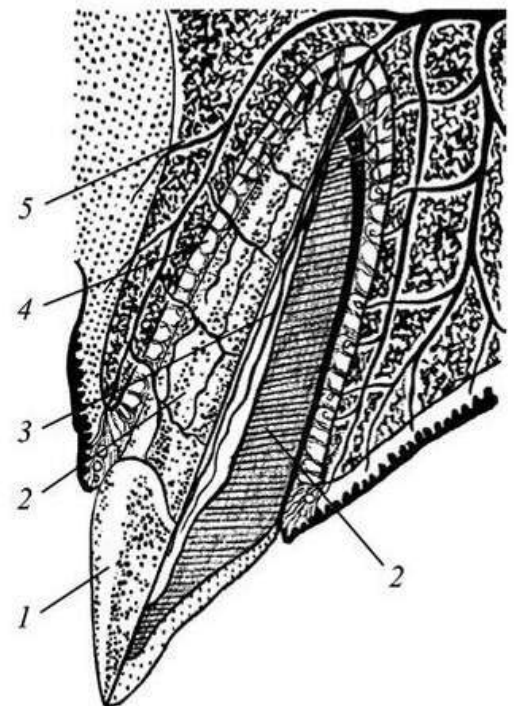
Cervical margin: — The junction of the anatomical crown and root.

Occlusal surface: — The biting surface of a molar or premolar.

Incisal margin: — The cutting edge of anterior teeth, analogous to the occlusal surface of the cheek teeth.

Cusp: — A pronounced elevation on the occlusal surface of a posterior tooth.

Fig. 15. The tooth structure: 1 — crown; 2 — root; 3 — pulp; 4 — periodontal ligament; 5 — alveolar bone



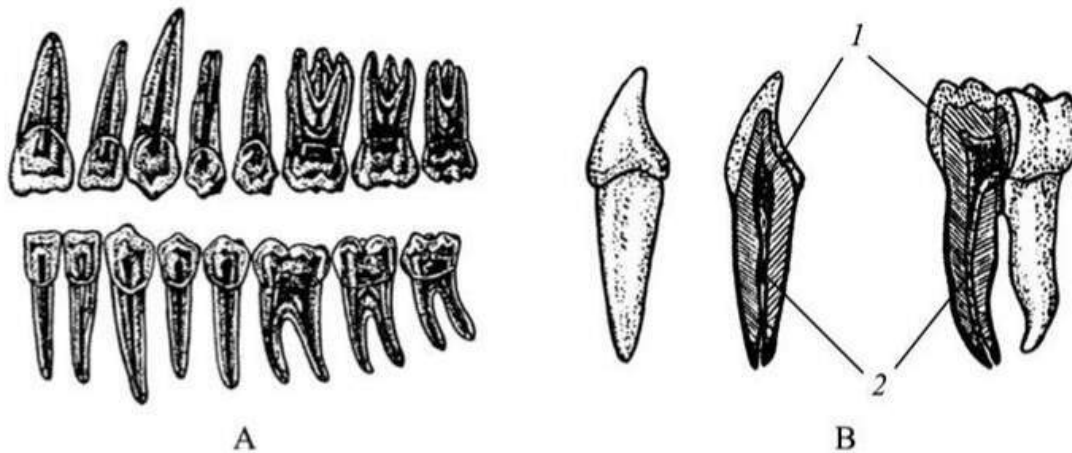


Fig. 16. A — pulp chamber and root canals anatomy of the human permanent teeth; B — coronal (1) and radicular (2) pulp

Tubercle: — A small elevation on the crown which may or may not be typical.

Cingulum: — A bulbous convexity near the cervical region of a tooth.

Ridge: — A linear elevation on the surface of a tooth.

Marginal ridge: — A ridge at the mesial or distal edge of the occlusal surface of posterior teeth. Some anterior teeth have equivalent ridges.

Fissure: — A long cleft between cusps or ridges.

Fossa: — A rounded depression in a surface of a tooth.

Buccal: — Towards or adjacent to the cheek. The term buccal surface is reserved for that surface of a premolar or molar which is positioned immediately adjacent to the cheek.

Labial: — Towards or adjacent to the lips. The term labial surface is reserved for that surface of an incisor or canine which is positioned immediately adjacent to the lips.

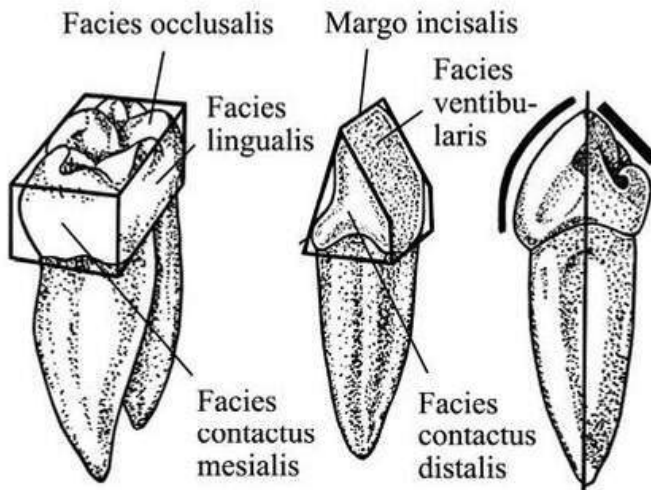
Palatal: — Towards or adjacent to the palate. The term palatal surface is reserved for that surface of a maxillary tooth which is positioned immediately adjacent to the palate.

Lingual: — Towards or adjacent to the tongue. The term lingual surface is reserved for that surface of mandibular tooth which lies immediately adjacent to the tongue.

Mesial: — Towards the median. The mesial surface is that surface which faces towards the median line following the curve of the dental arch.

Distal: — Away from the median. The distal surface is that surface which faces away from the median line following the curve of the dental arch (Fig. 17).

The types and numbers of teeth in any mammalian dentition can be expressed using dental formulae which, whatever the species, conform to a standard format. The type of tooth is represented by its initial letter, i.e. «I» for incisors, «C» for canines, «P» for premolars and «M» for molars. The deciduous dentition is indicated by the letter «D». The formula for the deciduous dentition of man is $DI2/2DC1/1DM2/2 = 10$,

**Fig. 17.** The tooth crown surfaces

and for the permanent dentition $I2/C1/1P2/2M3/3 = 16$, where the numbers following each letter refer to the number of teeth of each type in the upper and lower jaws on one side only.

Identification of teeth is made not only according to the dentition to which they belong and to basic tooth form, but also according to their ana-

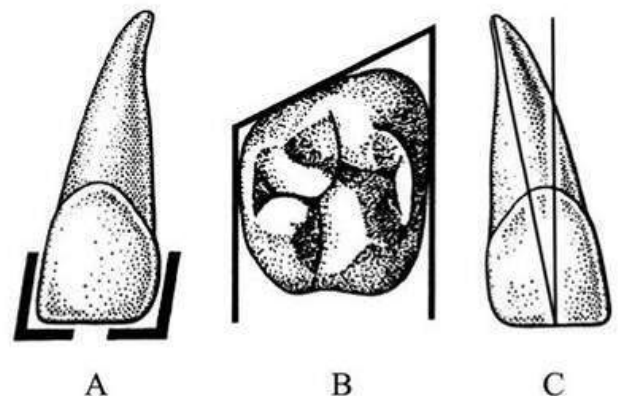
tomical location within the jaws. The tooth-bearing region of the jaws can be divided into four quadrants, the right and left maxillary and mandibular quadrants. A tooth may thus be identified according to the quadrant in which it is located, e.g. a right maxillary deciduous incisor or a left mandibular permanent molar. In both the permanent and deciduous dentitions, the incisors may be distinguished according to their relationship to the midline. Thus, the incisor nearest the midline is the central or first incisor, the incisor which is more laterally positioned being termed the lateral or second incisor. The permanent premolars and the permanent and deciduous molars can also be distinguished according to their mesiodistal relationships. The molar most mesially positioned is designated the first molar, the one behind it being the second molar. In the permanent dentition, the tooth most distally positioned is the third molar. The mesial premolar is the first premolar, the premolar behind it being the second premolar.

The teeth have some differences depending on the site and localization in the dental arch. There are several signs that make it easy to differentiate (Fig. 18).

Sign of the angle of the crown edge: The angle formed by the cutting edge of the mesial surface is sharper than the angle formed by the cutting edge and the distal surface of the tooth crown.

Sign of the curvature of the crown: The angle formed by the vestibular surface and mesial surface is sharper than the angle formed by vestibular surface and distal surface.

Sign of the root: The tooth root has apical inclination into the distal direction. A sign that is only visible on extracted teeth.

**Fig. 18.** Signs of the teeth

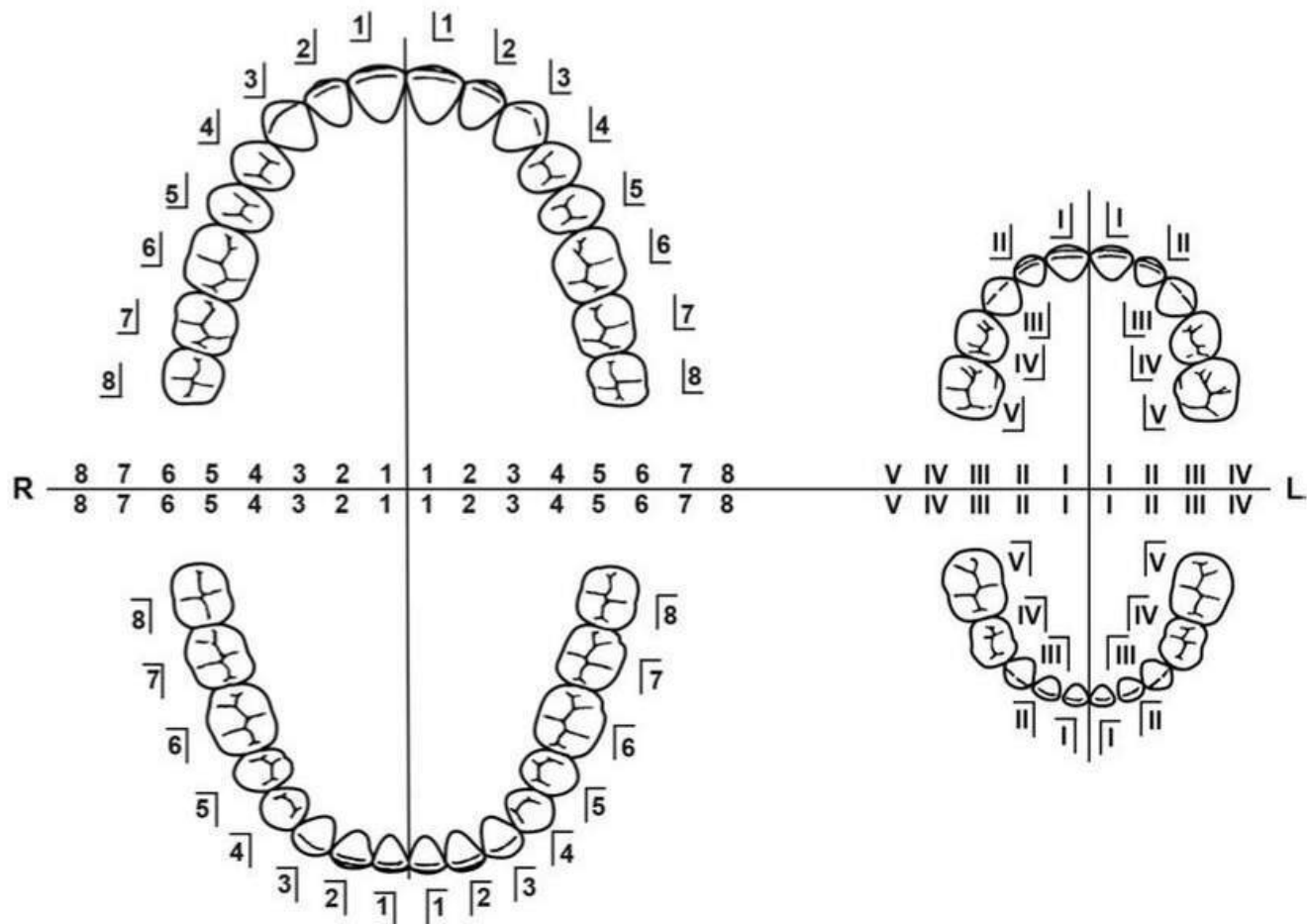


Fig. 19. A dental numbering system (A.Zsigmond, 1861)

Dental shorthand may be used in the clinic to simplify tooth identification. The permanent teeth in each quadrant of the jaws are numbered 1 to 8 and the deciduous teeth in each quadrant are numbered by roman numerals from I to V.

The symbols for the quadrants are derived from an imaginary cross with the horizontal bar placed between the upper and lower jaws and the vertical bar running between the upper and lower central incisors.

upper right	upper left
lower right	lower left

Thus, the maxillary right first permanent molar is allocated the symbol, 6 | and the mandibular left deciduous second molar |V. This system of dental numbering is termed the A. Zsigmondy (1861) system (Fig. 19).

Both the primary and permanent teeth are designated by the National or Universal Tooth Designation System. The need for a system that is able to be used internationally as well as by electronic data transfer is recognized — thus the acceptance of the International Standards Organization Designation System for Teeth (ISO System) by the World Health Organization (Fig. 20). With this system,

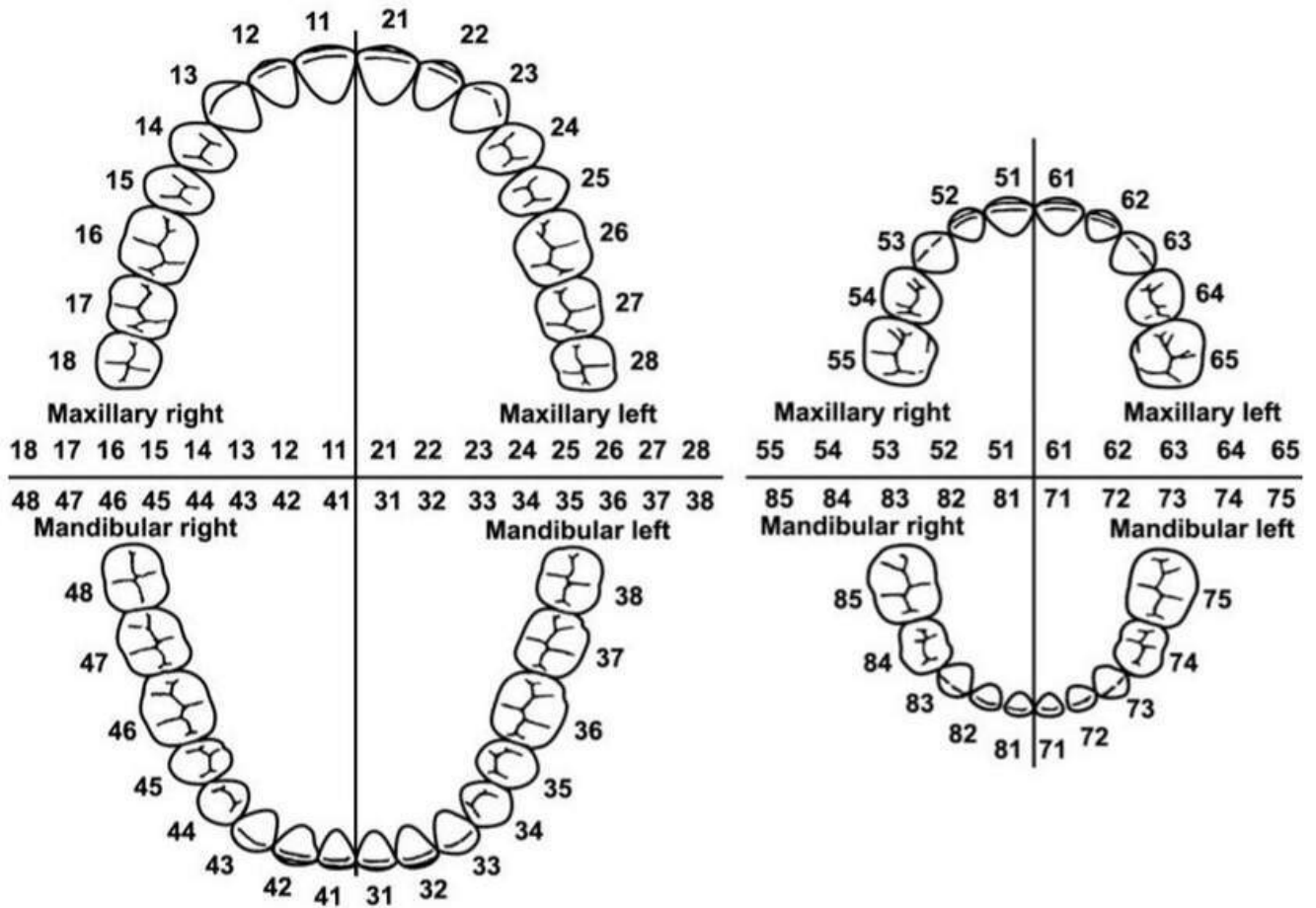


Fig. 20. The International Standards Organization Designation System for Teeth (ISO System)

the teeth are designated by using a two-digit code. The first digit of the code indicates the quadrant, and the second indicates the tooth in this quadrant. This is based on the Federation Dentitaire Internationale's (FDI) System.

Thus, with the ISO System, the digits 1 through 4 are used for quadrants in a clockwise manner in the permanent dentition and digits 5 through 8 are used in a clockwise manner for those quadrants of the primary dentition. For the second digit, which indicates the tooth, the digits 1 through 8 are used for the permanent teeth, and this designation is from the median line in a distal direction. The digits 1 through 5 are then used for the primary dentition, and this designation is also from the median line in a distal direction.

The American Dental Association tooth designation system is the most widely used system today in America for designation of both dentitions because it is adaptable to electronic data transfer. Each dentition also has a classical dental formula to be used when comparing our teeth with those of other animals. The permanent teeth are designated by the Universal Tooth Designation System in consecutive arrangement by using the digits 1 through 32, starting with the maxillary right third molar, moving clockwise, and ending with the mandibular right third molar (Fig. 21, A).

THE INCISORS

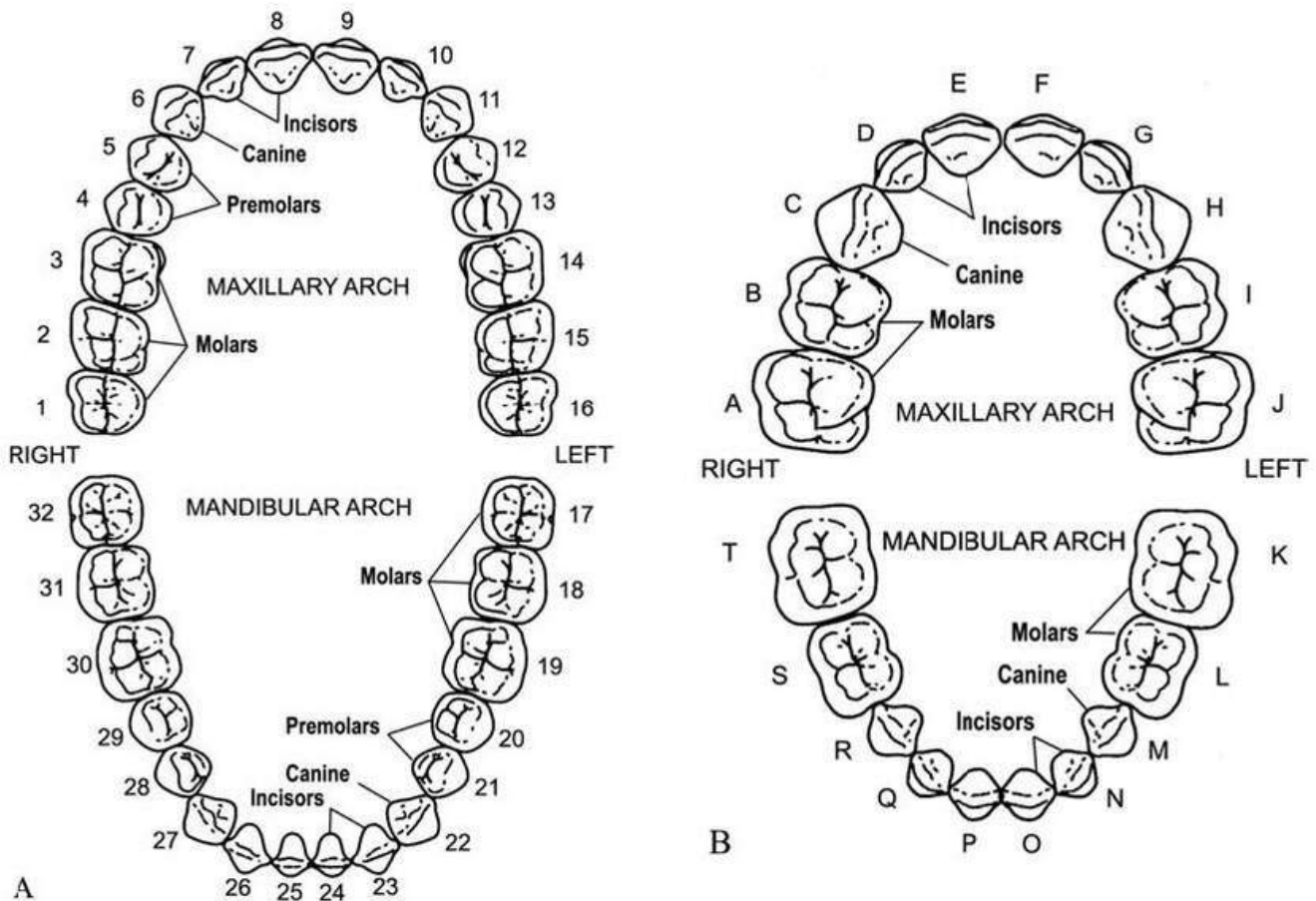


Fig. 21. The American Dental Association tooth designation system:
A – permanent teeth; B – primary teeth

With the Universal Tooth Designation System, the primary teeth are designated in a consecutive arrangement by using capital letters, *A* through *T*, starting with the maxillary right second molar, moving clockwise, and ending with the mandibular right second molar (Fig. 21, B).

THE INCISORS

The incisors of man have thin, blade-like crowns which are adapted for the cutting and shearing of food preparatory to grinding.

Viewed mesially or as distal, the crowns of the incisors are roughly triangular in shape, with the apex of the triangle at the incisal margin of the tooth. This shape is thought to facilitate the penetration and cutting of food. A buccal or lingual view, shows the incisors are trapezoidal, the shortest of the uneven sides being the base of the cervical crown.

Maxillary first (central) permanent incisor: Of all the permanent incisors and canines, the maxillary first permanent incisor is the widest mesiodistally, the crown being almost as wide as it is long (Fig. 22). Like all incisors, it is basically wedge-

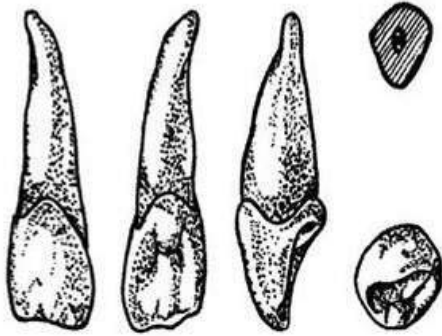


Fig. 22. Maxillary first (central) permanent incisor

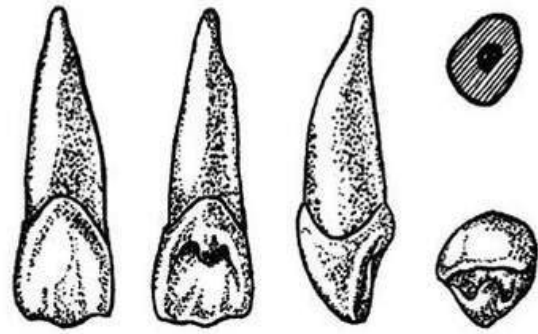


Fig. 23. Maxillary second (lateral) permanent incisor

shaped or chisel-shaped and has a single conical root. An *incisal* view, the crown and incisal margin are centrally positioned over the root of the tooth. The incisal margin presents as a narrow, flattened ridge rather than as a fine, sharp edge. The incisal margin may be grooved by two troughs, the labial lobe grooves, which correspond to the divisions between three developmental lobes or mamelons seen on newly erupted incisors. The mamelons are lost by attrition soon after eruption. From the incisal aspect, the crown outline is bilaterally symmetrical, being triangular. However, the mesial profile may appear slightly larger than the distal profile. A *labial* view, the crown length can be seen to be almost as great as the root length. The crown has a smooth, convex labial surface. It may be marked by two faint grooves which run vertically towards the cervical margin and which are extensions of the labial lobe grooves. The convexity of the labial surface is especially marked cervical, the labial surface sometimes being flat at its middle and incisal regions. The mesial surface is straight and approximately at right angles to the incisal margin. The distoincisor angle, however, is more rounded and the distal outline more convex. A line drawn through the axial centre of the tooth lies roughly parallel to the mesial outline of the crown and root. A *palatal* view shows the crown is more irregular, its middle and incisal regions being concave giving a slightly shovel-shaped appearance to the incisor. The palatal surface of the crown is bordered by mesial and distal marginal ridges. Near the cervical margin lies a prominent cingulum. The cingulum may be single, divided or replaced by prominent portions of the marginal ridges. Occasionally, a slight ridge of enamel may run towards the incisal margin, dividing the palatal surface into two shallow depressions. The *mesial* and *distal* views of the crown illustrate the fundamental wedge-shaped or triangular crown form of the incisor.

The sinuous cervical margin is concave towards the crown on the palatal and labial surfaces and convex towards the crown on the mesial and distal surfaces, the curvature on the mesial surface being the most pronounced of any tooth in the dentition. The single root of the central incisor tapers towards the apex. The root is conical in cross-section and appears narrower from the palatal than the labial aspect.

Maxillary second (lateral) permanent incisor: The lateral incisor is one of the most variable teeth in the dentition though generally it is morphologically a diminutive form of the maxillary central incisor with slight modifications (Fig. 23). The lateral incisor crown is much narrower and shorter than the central incisor, though the crown root length ratio is considerably decreased. An *incisal* aspect shows the crown has a more rounded outline than the adjacent central incisor. Viewed *labially*, the mesioincisal and distoincisor angles and the mesial and distal crown margins are more rounded than those of the central incisor. The *palatal* aspect of the crown is similar to that of the central incisor though the marginal ridges and cingulum are often more pronounced. Consequently, the palatal concavity appears deeper. Lying in front of the cingulum is a pit, the foramen cacumen, which may extend some way into the root. The *mesial* and *distal* aspects of the lateral incisor differ little from those of the central incisor. A common morphological variation is the so-called peg-shaped lateral incisor which has a thin root surmounted by a small conical crown.

The course of the cervical margin and the shape of the root are similar to the central incisor. However, the root is often slightly compressed and grooved on the mesial and distal surfaces.

The mandibular incisors have the smallest mesiodistal dimensions of any teeth in the permanent dentition. They can be distinguished from the maxillary incisors not only by their size but also by the marked lingual inclination of the crowns over the roots, the mesiodistal compression of their roots and the poor development of the marginal ridges and cingula.

Mandibular first (central) permanent incisor: An incisal view shows the tooth has a bilaterally symmetrical triangular shape (Fig. 24). The incisal margin in this specimen has been worn and appears flat, though in the newly-erupted tooth, three mamelons are usually present. The incisal margin is at right angles to a line bisecting the tooth labio-lingually. Viewed *labially*, the crown of the incisor is almost twice as long as it is broad. The unworn incisal margin is straight and approximately at right angles to the long axis of the tooth. The mesioincisal and distoincisor angles are sharp and the mesial and distal surfaces are approximately at right angles to the incisal margin. The profiles of the mesial and distal surfaces appear very similar, being convex in their incisal thirds and relatively flattened in the middle and cervical thirds. The *lingual* surfaces are smooth and slightly concave the lingual cingulum and mesial and distal marginal ridges appearing less distinct than those of the maxillary incisors. The *mesial* and *distal* aspects show the characteristic wedge-shape of the incisor and the inclination of the crown lingually over the root.

The cervical margins on the labial and lingual surfaces show their maximum convexities midway between the mesial and distal borders of the root. The cervical margin on the distal surface is said to be less curved than that on the mesial surface. The root is narrow and conical though flattened mesiodistally. It is frequently grooved on the mesial and distal surfaces, the distal groove generally being more marked and deeper.

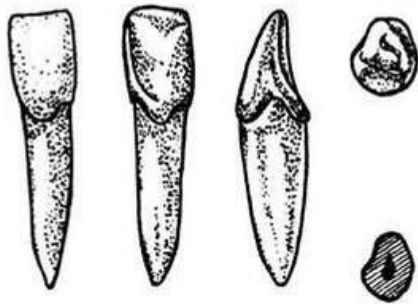


Fig. 24. Mandibular first (central) permanent incisor

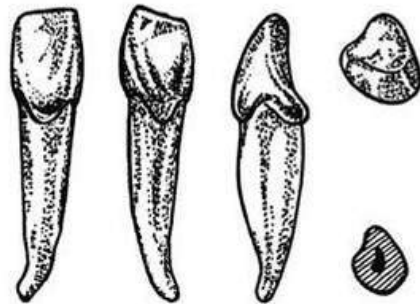


Fig. 25. Mandibular second (lateral) permanent incisor

Mandibular second (lateral) permanent incisor: This closely resembles the mandibular central incisor (Fig. 25). However, it is slightly wider mesiodistally and is more asymmetrical in shape. The distal surface diverges at a greater angle from the long axis of the tooth giving it a fan-shaped appearance and the distoincisor angle is more acute and rounded. Another distinguishing characteristic is the angulations of the incisal margin relative to the labio-lingual axis of the root. In the central incisor, the incisal margin forms a right angle with the labio-lingual axis, whereas that of the lateral incisor is 'twisted' distally in a lingual direction.

THE CANINES

Canines are the only teeth in the dentition with a single cusp. Morphologically, they can be considered transitional between incisors and premolars. Like the incisors, the crowns of canines are roughly triangular in shape when viewed mesially or distally and trapezoidal buccally and lingually.

Maxillary permanent canine: This is a stout tooth with a well-developed cingulum and the longest root of any tooth (Fig. 26). An *incisal* aspect, it appears asymmetrical. If a plane is envisaged passing through the apex of the cusp to the cingulum on the palatal surface, then the distal portion of the crown is much wider than the mesial portion. It is thought that the pointed shape of the canine tooth is related to an increase in size of a central mamelon at the expense of mesial and distal mamelons. Prominent longitudinal ridges pass from the cusp tip down both the labial and palatal surfaces. A relatively frequent variation in the morphology of the incisal ridge is the development of an accessory cusp on its distal arm. The *labial* surface of the canine is marked by the longitudinal ridge which extends from the cusp towards the cervical margin. The incisal part of the crown occupies at least one-third of the crown height. Note that from this aspect, the mesial arm of the incisal margin is shorter than the distal arm and the distoincisor angle is more rounded than the mesioincisor angle. The profiles of the mesial and distal surfaces converge markedly towards the cervix of the tooth. The mesial profile is slightly convex, the distal profile markedly convex. The mesial surface

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