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Introduction to Dental Anatomy

LEARNING OBJECTIVES

1. Correctly define and pronounce the nomenclature (terms) as emphasized in the bold type in this and each following chapter.
2. Be able to identify each tooth of the primary and permanent dentitions using the Universal, Palmer, and Fédération Dentaire Internationale (FDI) systems.
3. Correctly name and identify the surfaces, ridges, and anatomic landmarks of each tooth.
4. Understand and describe the methods used to measure anterior and posterior teeth.
5. Learn the tables of measurements and be able to discuss size comparisons between the teeth from any viewing angle. A useful skill at this point is to start illustrating the individual teeth with line drawings.

Pretest Questions

1. The dental formula for the permanent human dentition is which of the following?
 - A. $I\ 2/2\ C\ 1/1\ M\ 2/2 = 10$
 - B. $I\ 2/2\ C\ 1/1\ P\ 1/1\ M\ 2/2 = 12$
 - C. $I\ 2/2\ C\ 1/1\ P\ 2/2\ M\ 2/2 = 14$
 - D. $I\ 2/2\ C\ 1/1\ P\ 2/2\ M\ 3/3 = 16$
2. The notation for the primary mandibular left canine is which of the following according to the FDI system?
 - A. 53
 - B. 63
 - C. 73
 - D. 83
3. The notation for the primary maxillary left lateral incisor is which of the following according to the Universal system?
 - A. D
 - B. G
 - C. E
 - D. F
4. Which of the following represents the name of the bone of the tooth socket that firmly fixes each tooth root?
 - A. Alveolar process
 - B. Alveolus
 - C. Cementoenamel junction
 - D. Dentinoenamel junction
5. Which of the following terms represents the surface of a tooth that is facing toward an adjoining tooth in the same dental arch?
 - A. Occlusal
 - B. Incisal
 - C. Facial
 - D. Proximal

For additional study resources, please visit Expert Consult.

Dental anatomy is defined here as, but is not limited to, the study of the development, morphology, function, and identity of each of the teeth in the human dentitions, as well as the way in which the teeth relate in shape, form, structure, color, and function to the other teeth in the same dental arch and to the teeth in the opposing arch. Thus the study of dental anatomy, physiology, and occlusion provides one of the basic components of the skills needed to practice all phases of dentistry.

The application of dental anatomy to clinical practice can be envisioned in [Fig. 1.1A](#), where a faulty crown form has resulted in esthetic and periodontal problems that may be corrected by an appropriate restorative dental treatment, such as that illustrated in [Fig. 1.1B](#). The practitioner must have knowledge of the morphology, occlusion, esthetics, phonetics, and functions of these teeth to undertake such treatment.



• **Fig. 1.1** Restoration of maxillary central incisors with porcelain veneers taking into account esthetics, occlusion, and periodontal health. (Case and photographs courtesy of Michael P. Webberson, DDS, Las Vegas, NV.)

Formation of the Dentitions (Overview)

Humans have two sets of teeth in their lifetime. The first set of teeth to be seen in the mouth is the **primary** or **deciduous** dentition, which begins to form prenatally at approximately 14 weeks in utero and is completed postnatally at approximately 3 years of age. In the absence of congenital disorders, dental disease, or trauma, the first teeth in this dentition begin to appear in the oral cavity at the mean age of 6 months, and the last emerge at a mean age of 28 ± 4 months. The deciduous dentition remains intact (barring loss from dental caries or trauma) until the child is approximately 6 years of age. At approximately that time, the first **succedaneous** or **permanent** teeth begin to emerge into the mouth. The emergence of these teeth begins the **transition** or **mixed dentition period**, in which there is a mixture of deciduous and succedaneous teeth present. The transition period lasts from approximately 6 to 12 years of age and ends when all the deciduous teeth have been shed. At that time, the permanent dentition period begins. Thus the transition from the primary dentition to the permanent dentition begins with the emergence of the first permanent molars, shedding of the deciduous incisors, and emergence of the permanent incisors. The mixed dentition period is often a difficult time for the young child because of habits, missing teeth, teeth of different colors and hues, crowding of the teeth, and malposed teeth.

The permanent, or succedaneous, teeth replace the exfoliated deciduous teeth in a sequence of eruption that exhibits some variance, an important topic considered in [Chapter 16](#).

After the shedding of the deciduous canines and molars, emergence of the permanent canines and premolars, and emergence of the second permanent molars, the permanent dentition is completed (including the roots) at approximately 14 to 15 years of age, except for the third molars, which are completed at 18 to 25 years of age. In effect, the duration of the permanent dentition period is 12 or more years. The completed permanent dentition consists of 32 teeth if none is congenitally missing, which may be the case. The development of the teeth, dentitions, and the craniofacial complex is considered in [Chapter 2](#). The development of occlusion for both dentitions is discussed in [Chapter 16](#).

Nomenclature

The first step in understanding dental anatomy is to learn the nomenclature, or the system of names, used to describe or classify the material included in the subject. When a significant term is used for the first time here, it is emphasized in bold. Additional terms are discussed as needed in subsequent chapters.

The term **mandibular** refers to the lower jaw, or mandible. The term **maxillary** refers to the upper jaw, or maxilla. When more than one name is used in the literature to describe something, the two most commonly used names will be used initially. After that, they may be combined or used separately, as consistent with the literature of a particular specialty of dentistry, for example, **primary** or **deciduous dentition**, **permanent** or **succedaneous dentition**. A good case may be made for the use of both terms. By dictionary definition,¹ the term *primary* can mean “constituting or belonging to the first stage in any process.” The term *deciduous* can mean “not permanent, transitory.” The same unabridged dictionary refers the reader from the definition of *deciduous tooth* to *milk tooth*, which is defined as “one of the temporary teeth of a mammal that are replaced by permanent teeth; also called *baby tooth*, *deciduous tooth*.” The term *primary* can indicate a first dentition, and the term *deciduous* can indicate that the first dentition is

not permanent but not unimportant. The term *succedaneous* can be used to describe a successor dentition and does not suggest permanence, whereas the term *permanent* suggests a permanent dentition, which may not be the case because of dental caries, periodontal diseases, and trauma. All four of these descriptive terms appear in the professional literature.

Formulae for Mammalian Teeth

The denomination and number of all mammalian teeth are expressed by formulae that are used to differentiate the human dentitions from those of other species. The denomination of each tooth is often represented by the initial letter in its name (e.g., I for incisor, C for canine, P for premolar, M for molar). Each letter is followed by a horizontal line and the number of each type of tooth is placed above the line for the maxilla (upper jaw) and below the line for the mandible (lower jaw). The formulae include one side only, with the number of teeth in each jaw being the same for humans.

The dental formula for the primary/deciduous teeth in humans is as follows:

$$\begin{array}{c} 2 \\ \hline \text{I} - \text{C} - \text{M} \\ \hline 2 \quad 1 \quad 2 \end{array} = 10$$

This formula should be read as: incisors, two maxillary and two mandibular; canines, one maxillary and one mandibular; molars, two maxillary and two mandibular—or 10 altogether on one side, right or left ([Fig. 1.2A](#)).

A dental formula for the permanent human dentition is as follows:

$$\begin{array}{c} 2 \\ \hline \text{I} - \text{C} - \text{P} - \text{M} \\ \hline 2 \quad 1 \quad 2 \quad 3 \end{array} = 16$$

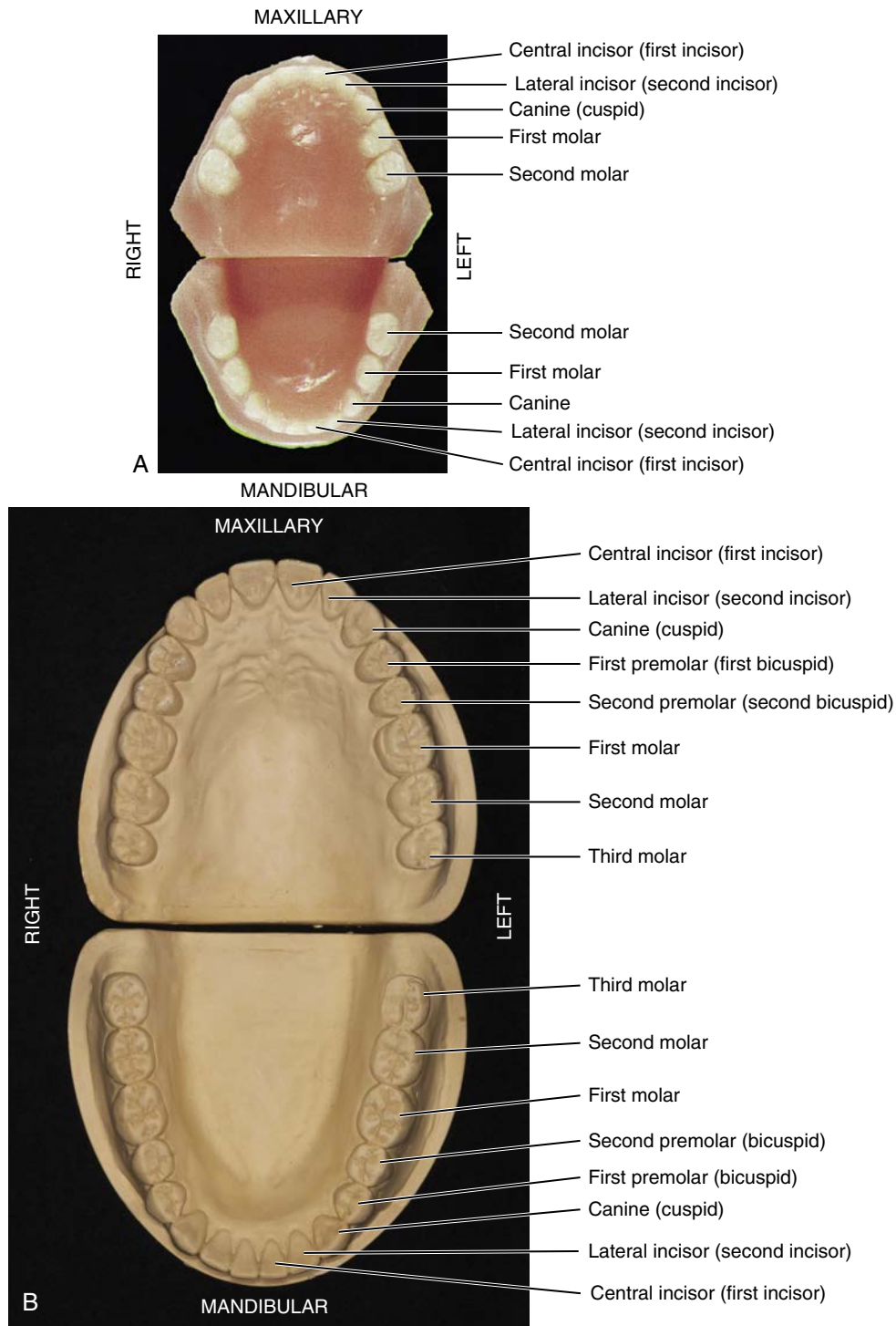
Premolars have now been added to the formula, two maxillary and two mandibular, and a third molar has been added, one maxillary and one mandibular (see [Fig. 1.2B](#)).

Systems for scoring key morphologic traits of the permanent dentition that are used for anthropologic studies are not described here. However, a few of the morphologic traits that are used in anthropologic studies² are considered in later chapters (e.g., shoveling, Carabelli trait, enamel extensions, peg-shaped incisors). Some anthropologists use di_1 , di_2 , dc , dm_1 , and dm_2 notations for the deciduous dentition and I_1 , I_2 , C , P_1 , P_2 , M_1 , M_2 , and M_3 for the permanent teeth. These notations are generally limited to anthropologic tables because of keyboard incompatibility.

Tooth Numbering Systems

In clinical practice, some “shorthand” system of tooth notation is necessary for recording data. Several systems are in use around the world, but only a few are considered here. In 1947 a committee of the American Dental Association (ADA) recommended the symbolic system (Zsigmondy/Palmer) as the numbering method of choice.³ However, because of difficulties with keyboard notation of the symbolic notation system, the ADA in 1968 officially recommended the “universal” numbering system. Because of some limitations and lack of widespread use internationally, recommendations for a change sometimes are made.⁴

The **Universal** system of notation for the primary dentition uses uppercase letters for each of the primary teeth: For the maxillary teeth, beginning with the right second molar, letters A through J, and for the mandibular teeth, letters K through T, beginning with



• **Fig. 1.2** (A) Casts of deciduous, or primary, dentition. (B) Casts of permanent dentition. (A, From Berkovitz BK, Holland GR, Moxham BJ: *Oral anatomy, histology and embryology*, ed 3, St Louis, 2002, Mosby.) (To view Animations 1 and 2, please go to Expert Consult.)

the left mandibular second molar. The Universal system notation for the entire primary dentition is as follows:

Midsagittal Plane											
↓											
Right	A	B	C	D	E	F	G	H	I	J	Left
	T	S	R	Q	P	O	N	M	L	K	

The **symbolic** system for the permanent dentition was introduced by Adolph Zsigmondy of Vienna in 1861 and then modified for the primary dentition in 1874. Independently, Palmer also published the symbolic system in 1870. The symbolic system is most often referred to as the **Palmer notation system** in the United States and less frequently as the **Zsigmondy/Palmer notation system**. In this system the arches are divided into quadrants, with the entire dentition being notated as follows:

E	D	C	B	A	A	B	C	D	E
E	D	C	B	A	A	B	C	D	E

Thus, for a single tooth such as the maxillary right central incisor, the designation is A. For the mandibular left central incisor, the notation is given as Ā. This numbering system presents difficulty when an appropriate font is not available for keyboard recording of Zsigmondy/Palmer symbolic notations. For simplification, this symbolic notation is often designated as Palmer dental notation rather than Zsigmondy/Palmer notation.

In the **Universal notation system** for the permanent dentition, the maxillary teeth are numbered from 1 through 16, beginning with the right third molar. Beginning with the mandibular left third molar, the teeth are numbered 17 through 32. Thus the right maxillary first molar is designated as 3, the maxillary left central incisor as 9, and the right mandibular first molar as 30. The following universal notation designates the entire permanent dentition:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17

The Zsigmondy/Palmer notation for the permanent dentition is a four-quadrant symbolic system in which, beginning with the central incisors, the teeth are numbered 1 through 8 (or more) in each arch. For example, the right maxillary first molar is designated as 6, and the left mandibular central incisor as Ī. The Palmer notation for the entire permanent dentition is as follows:

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

Viktor Haderup of Denmark in 1891 devised a variant of the eight-tooth quadrant system in which plus (+) and minus (−) were used to differentiate between upper and lower quadrants and between right and left quadrants. In other words, +1 indicates the upper left central incisor, and 1− indicates the lower right central incisor. Primary teeth were numbered as follows: upper right, 05+ to 01+; lower left, −01 to −05. This system is still taught in Denmark.⁵

The Universal system is acceptable to computer language, whereas the Palmer notation is generally incompatible with computers and word-processing systems. Each tooth in the universal

system is designated with a unique number, which leads to less confusion than with the Palmer notation.

A two-digit system proposed by Fédération Dentaire Internationale (FDI) for both the primary and permanent dentitions has been adopted by the World Health Organization and accepted by other organizations, such as the International Association for Dental Research. The FDI system of tooth notation is as follows.

For the primary teeth:

Upper Right						Upper Left					
55	54	53	52	51	61	62	63	64	65		
85	84	83	82	81	71	72	73	74	75		
Lower Right						Lower Left					

Numeral 5 indicates the maxillary right side, and 6 indicates the maxillary left side. The second number of the two-digit number is the tooth number for each side. The number 8 indicates the mandibular right side, and the number 7 indicates the mandibular left side. The second number of the two-digit system is the tooth number. Thus, for example, the number 51 refers to the **maxillary right central incisor**.

For the permanent teeth:

Upper Right								Upper Left							
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Lower Right								Lower Left							

Thus, as in the two-digit FDI system for the primary dentition, the first digit indicates the quadrant: 1 to 4 for the permanent dentition and 5 to 8 for the primary dentition. The second digit indicates the tooth within a quadrant: 1 to 8 for the permanent teeth and 1 to 5 for the primary teeth. For example, the permanent upper right central incisor is 11 (pronounced “one one,” not “eleven”).

Crown and Root

Each tooth has a crown and root portion. The crown is covered with enamel, and the root portion is covered with cementum. The crown and root join at the **cementoenamel junction** (CEJ). This junction, also called the **cervical line** (Fig. 1.3), is plainly visible on a specimen tooth. The main bulk of the tooth is composed of **dentin**, which is clear in a cross section of the tooth. This cross section displays a pulp chamber and a pulp canal, which normally contain the pulp tissue. The **pulp chamber** is in the crown portion mainly, and the **pulp canal** is in the root (Fig. 1.4). The spaces are continuous with each other and are spoken of collectively as the **pulp cavity**.

The four tooth tissues are *enamel*, *cementum*, *dentin*, and *pulp*. The first three are known as **hard tissues**, the last as **soft tissue**. The pulp tissue furnishes the blood and nerve supply to the tooth. The tissues of the teeth must be considered in relation to the other tissues of the orofacial structures (Figs. 1.5 and 1.6) if the physiology of the teeth is to be understood.

The crown of an incisor tooth may have an incisal ridge or edge, as in the central and lateral incisors; a single cusp, as in the canines; or two or more cusps, as on premolars and molars.

Incisal ridges and cusps form the cutting surfaces on tooth crowns.

The root portion of the tooth may be single, with one apex or terminal end, as usually found in anterior teeth and some of the premolars; or multiple, with a bifurcation or trifurcation

dividing the root portion into two or more extensions or roots with their apices or terminal ends, as found on all molars and in some premolars.

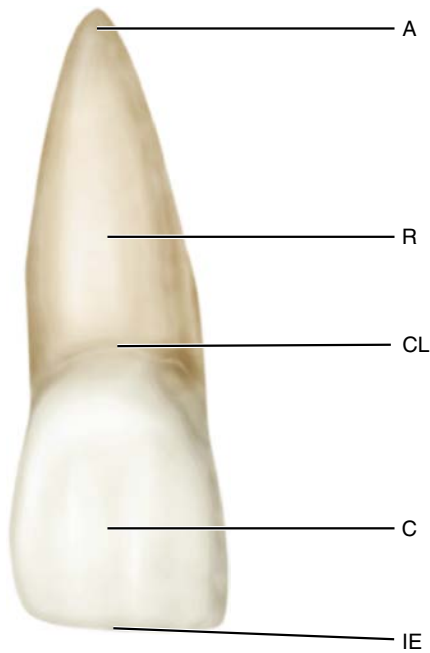
The root portion of the tooth is firmly fixed in the bony process of the jaw, so that each tooth is held in its position relative to the others in the dental arch. That portion of the jaw serving as support for the tooth is called the **alveolar process**. The bone of the tooth socket is called the *alveolus* (plural *alveoli*) (Fig. 1.7).

The crown portion is never covered by bone tissue after it is fully erupted, but it is partly covered at the cervical third in young adults by soft tissue of the mouth known as the *gingiva* or *gingival tissue*, or “gums.” In some persons, all the enamel and frequently some cervical cementum may not be covered by the gingiva.

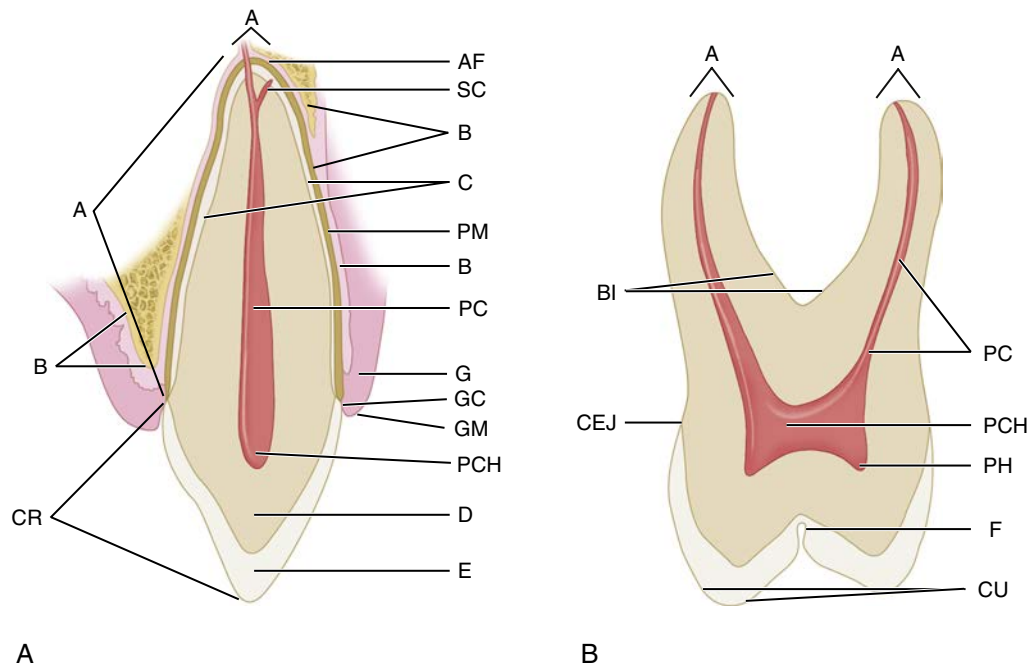
Surfaces and Ridges

The crowns of the incisors and canines have four surfaces and a ridge, and the crowns of the premolars and molars have five surfaces. The surfaces are named according to their positions and uses (Fig. 1.8). In the incisors and canines, the surfaces toward the lips are called **labial surfaces**; in the premolars and molars, those facing the cheek are the **buccal surfaces**. When labial and buccal surfaces are referred to collectively, they are called **facial surfaces**. All surfaces facing toward the tongue are called **lingual surfaces**. The surfaces of the premolars and molars that come in contact (occlusion) with those in the opposite jaw during the act of closure are called **occlusal surfaces**. These are called **incisal surfaces** with respect to incisors and canines.

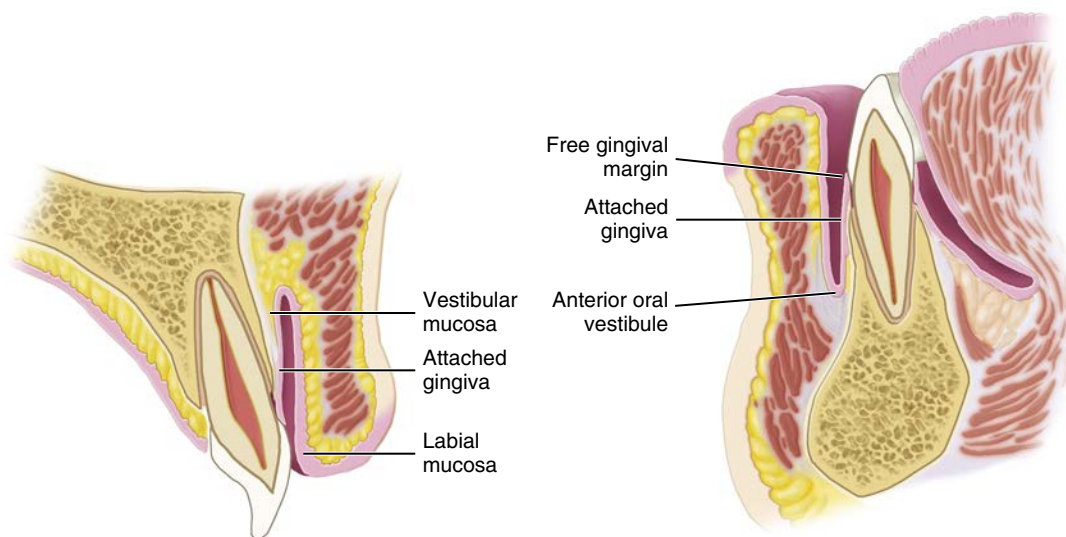
The surfaces of the teeth facing toward adjoining teeth in the same dental arch are called **proximal** or **proximate surfaces**. The proximal surfaces may be called either **mesial** or **distal**. These terms have special reference to the position of the surface relative to the median line of the face. This line is drawn vertically through the



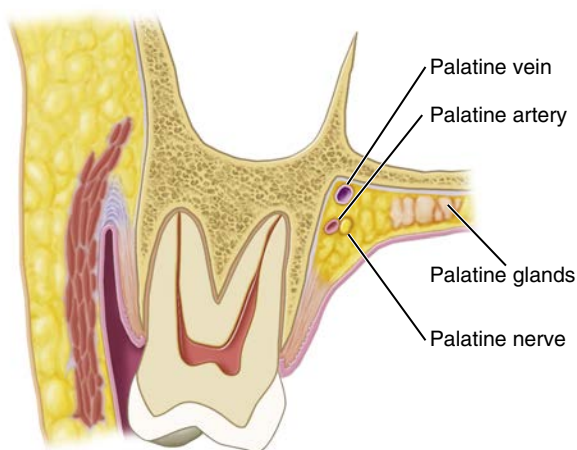
• **Fig. 1.3** Maxillary central incisor (facial aspect). A, Apex of root; C, Crown; CL, Cervical line; IE, Incisal edge; R, Root. (To view Animations 3 and 4, please go to Expert Consult.)



• **Fig. 1.4** Schematic drawings of longitudinal sections of an anterior and a posterior tooth. (A) Anterior tooth. A, Apex; AF, apical foramen; B, bone; C, cementum; CR, crown; D, dentin; E, enamel; G, gingiva; GC, gingival crevice; GM, gingival margin; PC, pulp canal; PCH, pulp chamber; PM, periodontal ligament; SC, supplementary canal. (B) Posterior tooth. A, Apices; BI, bifurcation of roots; CEJ, cemento-enamel junction; CU, cusp; F, fissure; PC, pulp canal; PCH, pulp chamber; PH, pulp horn.



• **Fig. 1.5** Sagittal sections through the maxillary and mandibular central incisors.



• **Fig. 1.6** Section through the second maxillary molar and adjacent tissues.

center of the face, passing between the central incisors at their point of contact with each other in both the maxilla and the mandible. Those proximal surfaces that, following the curve of the arch, are faced toward the median line are called **mesial surfaces**, and those most distant from the median line are called **distal surfaces**.

Four teeth have mesial surfaces that contact each other: the **maxillary** and **mandibular central incisors**. In all other instances, the mesial surface of one tooth contacts the distal surface of its neighbor, except for the distal surfaces of third molars of permanent teeth and distal surfaces of second molars in deciduous teeth, which have no teeth distal to them. The area of the mesial or distal surface of a tooth that touches its neighbor in the arch is called the **contact area**.

Central and lateral incisors and canines as a group are called **anterior teeth**; premolars and molars as a group, **posterior teeth**.

Other Landmarks

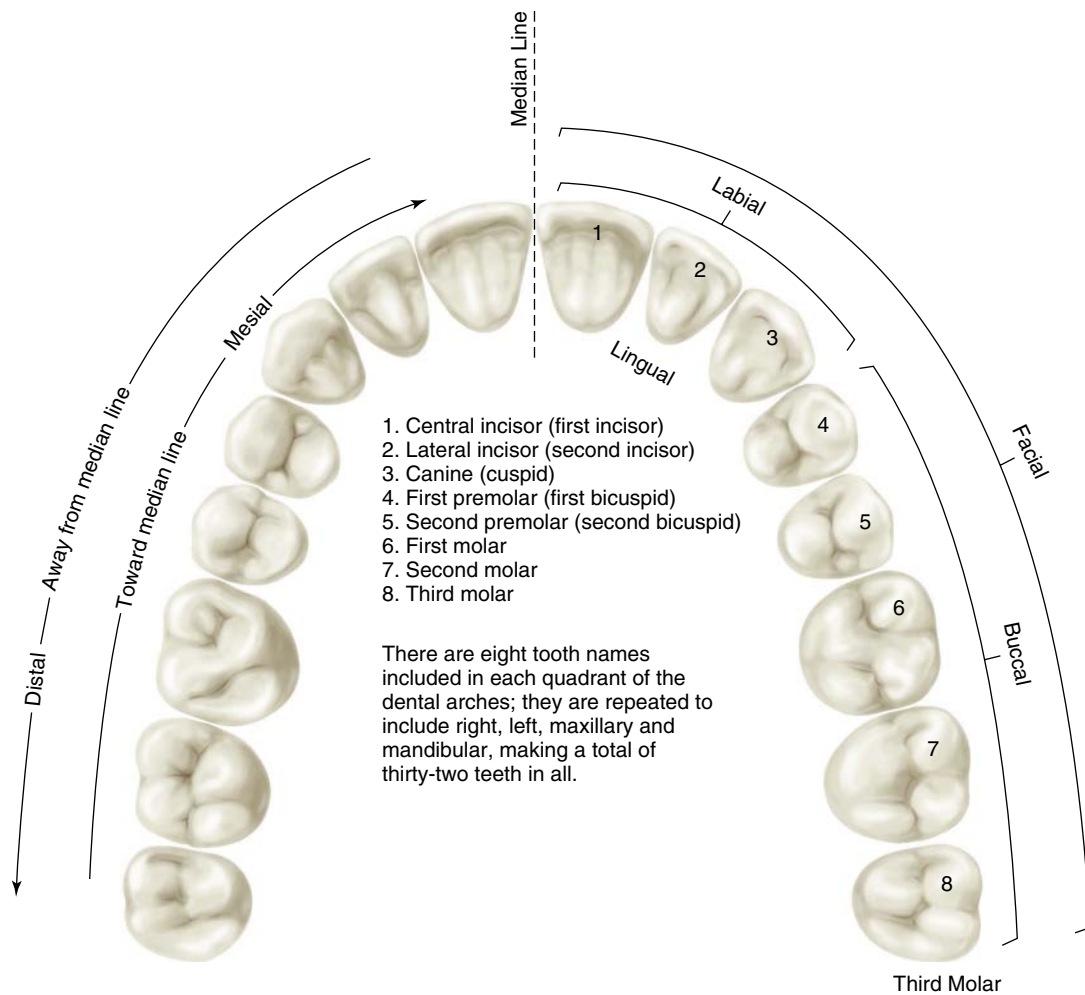
To study an individual tooth intelligently, one should recognize all landmarks of importance by name. Therefore, at this point, it



• **Fig. 1.7** Left maxillary bone showing the alveoli for the incisors, canines, and premolar and molar teeth.

is necessary to become familiar with additional terms, such as the following:

cuspid	triangular ridge	developmental groove
tubercle	transverse ridge	supplemental groove
cingulum	oblique ridge	pit
ridge	fossa	lobe
marginal ridge	sulcus	



• **Fig. 1.8** Application of nomenclature. Tooth numbers 11 to 18 indicating left maxillary teeth. Tooth surfaces related to the tongue (*lingual*), cheek (*buccal*), lips (*labial*), and face (*facial*), apply to four quadrants and the upper left quadrant. The teeth or their parts or surfaces may be described as being away from the midline (*distal*) or toward the midline (*mesial*).

A **cusp** is an elevation or mound on the crown portion of a tooth making up a divisional part of the occlusal surface (Fig. 1.9; see also Fig. 1.4).

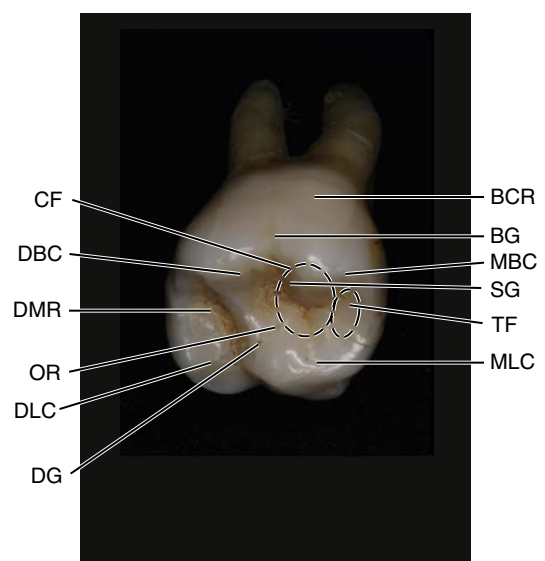
A **tubercle** is a smaller elevation on some portion of the crown produced by an extra formation of enamel (see Fig. 4.14A). These are deviations from the typical form.

A **cingulum** (Latin word for “girdle”) is the lingual lobe of an anterior tooth. It makes up the bulk of the cervical third of the lingual surface. Its convexity mesiodistally resembles a girdle encircling the lingual surface at the cervical third (Figs. 1.10; see also Fig. 4.13A).

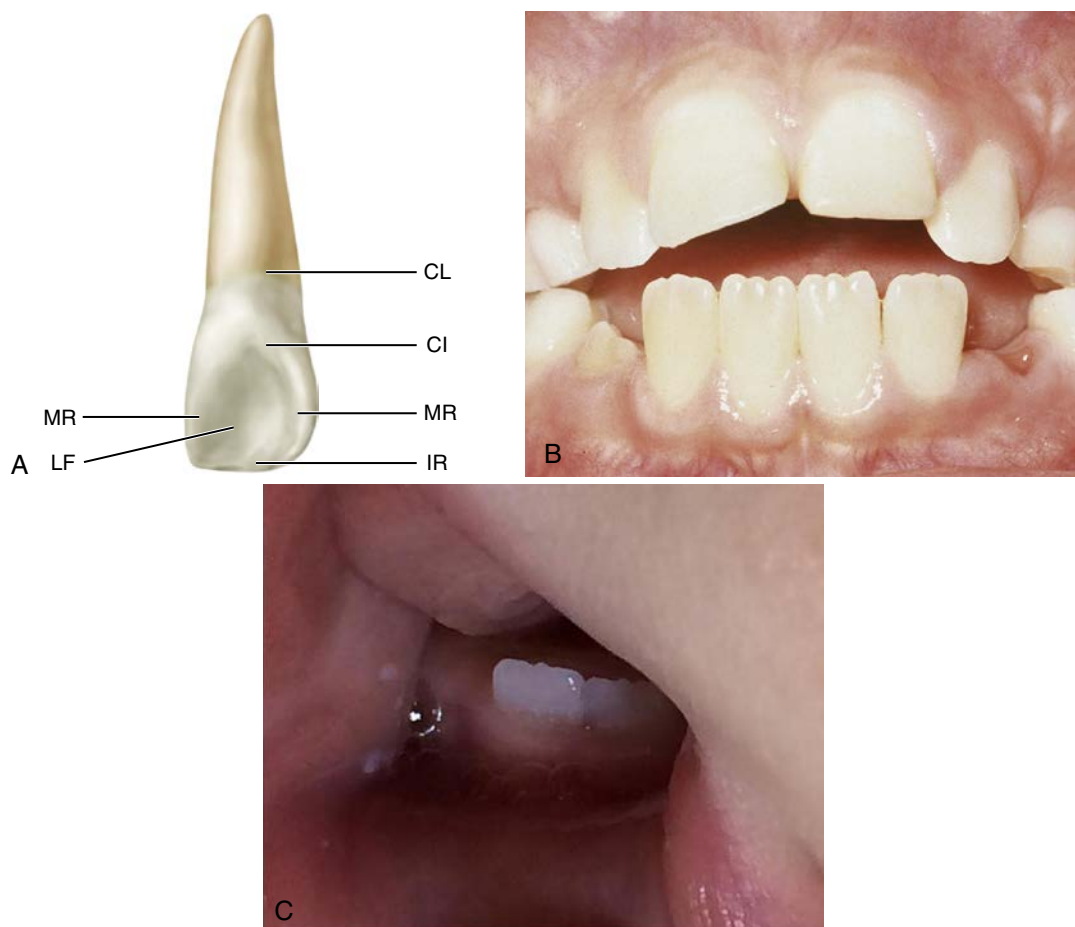
A **ridge** is any linear elevation on the surface of a tooth and is named according to its location (e.g., buccal ridge, incisal ridge, marginal ridge).

Marginal ridges are the rounded borders of the enamel that form the mesial and distal margins of the occlusal surfaces of premolars and molars, as well as the mesial and distal margins of the lingual surfaces of the incisors and canines (Fig. 1.11A; see also Figs 1.10A).

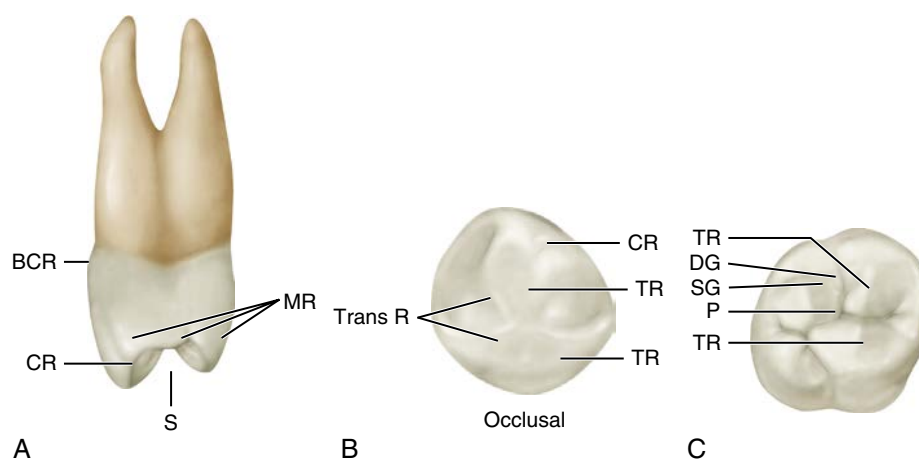
Triangular ridges descend from the tips of the cusps of molars and premolars toward the central part of the occlusal surfaces. They are so named because the slopes of each side of the ridge are inclined to resemble two sides of a triangle (Fig. 1.12; see also Figs. 1.11B and C). They are named after the cusps to which they



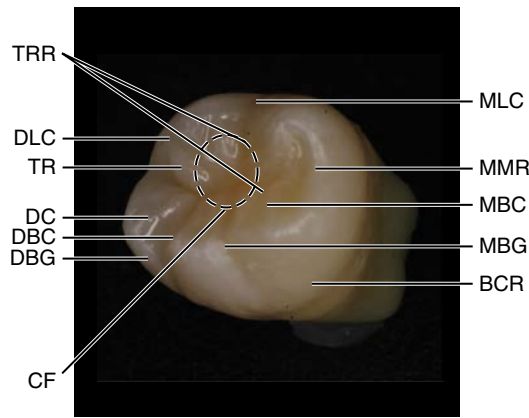
• **Fig. 1.9** Some landmarks on the maxillary first molar. BCR, Buccocervical ridge; BG, buccal groove; CF, central fossa; DBC, distobuccal cusp; DG, developmental groove; DLC, distolingual cusp; DMR, distal marginal ridge; MBC, mesiobuccal cusp; MLC, mesiolingual cusp; OR, oblique ridge; SG, supplemental groove; TF, triangular fossa. (To view Animations 3 and 4 for tooth #3, please go to Expert Consult.)



• **Fig. 1.10** (A) Maxillary right lateral incisor (lingual aspect). *CI*, Cingulum (also called the linguocervical ridge); *CL*, cervical line; *IR*, incisal ridge; *LF*, lingual fossa; *MR*, marginal ridge. (B) Mamelons on erupting, noncontacting central incisors. (C) Mamelon-like serrations on primary incisors. (B, From Bath-Balogh M, Fehrenbach MJ: *Illustrated dental embryology, histology, and anatomy*, ed 2, St Louis, 2006, Saunders.)



• **Fig. 1.11** (A) Mesial view of a maxillary right first premolar. *BCR*, Buccocervical ridge; *CR*, cusp ridge; *MR*, marginal ridge; *S*, sulcus traversing occlusal surface. (B) Occlusal view of mandibular right first premolar. *CR*, Cusp ridge; *TR*, triangular ridges; *Trans R*, transverse ridge, formed by two triangular ridges that cross the tooth transversely. (C) Occlusal view of a maxillary right first molar. *DG*, Developmental groove; *P*, pit formed by junction of developmental grooves; *SG*, supplemental groove; *TR*, triangular ridge.



• **Fig. 1.12** Mandibular right first molar. *BCR*, Buccocervical ridge; *CF*, central fossa; *DBC*, distobuccal cusp; *DBG*, distobuccal groove; *DC*, distal cusp; *DLC*, distolingual cusp; *MBC*, mesiobuccal cusp; *MBG*, mesiobuccal groove; *MLC*, mesiobuccal groove; *MMR*, mesial marginal ridge; *TR*, triangular ridge; *TRR*, transverse ridge. (To view Animations 3 and 4 for tooth #30, please go to Expert Consult.)

belong, for example, the triangular ridge of the buccal cusp of the maxillary first premolar.

When a buccal and a lingual triangular ridge join, they form a **transverse ridge**. A transverse ridge is the union of two triangular ridges crossing transversely the surface of a posterior tooth (see Fig. 1.11B and C).

The **oblique ridge** is a ridge crossing obliquely the occlusal surfaces of maxillary molars and formed by the union of the triangular ridge of the distobuccal cusp and the distal cusp ridge of the mesiolingual cusp (see Fig. 1.9).

A **fossa** is an irregular depression or concavity. **Lingual fossae** are on the lingual surface of incisors (see Fig. 1.10). **Central fossae** are on the occlusal surface of molars. They are formed by the convergence of ridges terminating at a central point in the bottom of the depression where there is a junction of grooves (see Fig. 1.12). **Triangular fossae** are found on molars and premolars on the occlusal surfaces mesial or distal to marginal ridges (see Fig. 1.9). They are sometimes found on the lingual surfaces of maxillary incisors at the edge of the lingual fossae where the marginal ridges and the cingulum meet (see Fig. 4.14A).

A **sulcus** is a long depression or valley in the surface of a tooth between ridges and cusps, the inclines of which meet at an angle. A sulcus has a developmental groove at the junction of its inclines. (The term *sulcus* should not be confused with the term *groove*.)

A **developmental groove** is a shallow groove or line between the primary parts of the crown or root. A **supplemental groove**, less distinct, is also a shallow linear depression on the surface of a tooth, but it is supplemental to a developmental groove and does not mark the junction of primary parts. **Buccal and lingual grooves** are developmental grooves found on the buccal and lingual surfaces of posterior teeth (see Figs. 1.9 and 1.12).

Pits are small pinpoint depressions located at the junction of developmental grooves or at terminals of those grooves. For example, *central pit* is a term used to describe a landmark in the central fossa of molars where developmental grooves join (see Fig. 1.11C).

A **lobe** is one of the primary sections of formation in the development of the crown. Cusps and mamelons are representative of lobes. A **mamelon** is any one of the three rounded protuberances found on the incisal ridges of newly erupted incisor teeth.

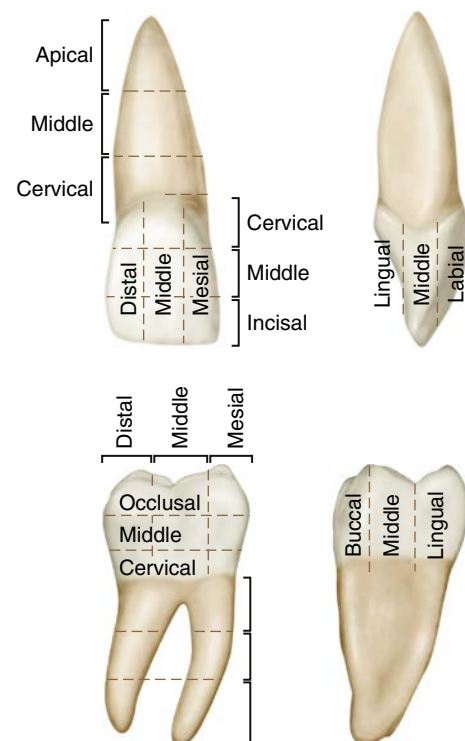
Although they are generally considered to be a feature of the permanent incisors, mamelon-like serrations may also be found on newly erupted primary incisors (see Fig. 1.10B and C).⁶ (For further description of lobes, see Figs. 4.11 to 4.14.)

The **roots** of the teeth may be single or multiple. Both maxillary and mandibular anterior teeth have only one root each. Mandibular first and second premolars and the maxillary second premolar are single rooted, but the maxillary first premolar has two roots in most cases, one buccal and one lingual. Maxillary molars have three roots, one mesiobuccal, one distobuccal, and one lingual. Mandibular molars have two roots, one mesial and one distal. It must be understood that descriptions in anatomy can never follow a hard-and-fast rule. Variations frequently occur. This is especially true regarding tooth roots, such as the facial and lingual roots of the mandibular canine.

Division Into Thirds, Line Angles, and Point Angles

For purposes of description, the crowns and roots of teeth have been divided into thirds, and junctions of the crown surfaces are described as line angles and point angles. Actually, there are no angles or points or plane surfaces on the teeth anywhere except those that appear from wear (e.g., **attrition**, **abrasion**) or from accidental fracture. *Line angle* and *point angle* are used only as descriptive terms to indicate a location.

When the surfaces of the crown and root portions are divided into thirds, these thirds are named according to their location. Looking at the tooth from the labial or buccal aspect, we see that the crown and root may be divided into thirds from the incisal or occlusal surface of the crown to the apex of the root (Fig. 1.13). The crown is divided into an incisal or occlusal third, a middle



• **Fig. 1.13** Division into thirds.

third, and a cervical third. The root is divided into a cervical third, a middle third, and an apical third.

The crown may be divided into thirds in three directions: incisocervically or occlusocervically, mesiodistally, or labiolingually or buccolingually. Mesiodistally, it is divided into the mesial, middle, and distal thirds. Labiolingually or buccolingually, it is divided into labial or buccal, middle, and lingual thirds. Each of the five surfaces of a crown may be so divided. There will be one middle third and two other thirds, which are named according to their location (e.g., cervical, occlusal, mesial, lingual).

A **line angle** is formed by the junction of two surfaces and derives its name from the combination of the two surfaces that join. For example, on an anterior tooth, the junction of the mesial and labial surfaces is called the **mesiolabial line angle**.

The line angles of the **anterior teeth** (Fig. 1.14A) are as follows:

mesiolabial	distolingual
distolabial	labioincisal
mesiolingual	linguoincisal

Because the mesial and distal incisal angles of anterior teeth are rounded, **mesioincisal line angles** and **distoincisal line angles** are usually considered nonexistent. They are spoken of as **mesial** and **distal incisal angles** only.

The **line angles** of the **posterior teeth** (see Fig. 1.14B) are as follows:

mesio Buccal	distolingual	bucco-occlusal
distobuccal	mesio-occlusal	linguo-occlusal
mesiolingual	disto-occlusal	

A **point angle** is formed by the junction of three surfaces. The point angle also derives its name from the combination of the names of the surfaces forming it. For example, the junction of the mesial, buccal, and occlusal surfaces of a molar is called the **mesio Buccal-occlusal point angle**.

The **point angles** of the **anterior teeth** are (Fig. 1.15A):

mesiolabioincisal	mesiolinguoincisal
distolabioincisal	distolinguoincisal

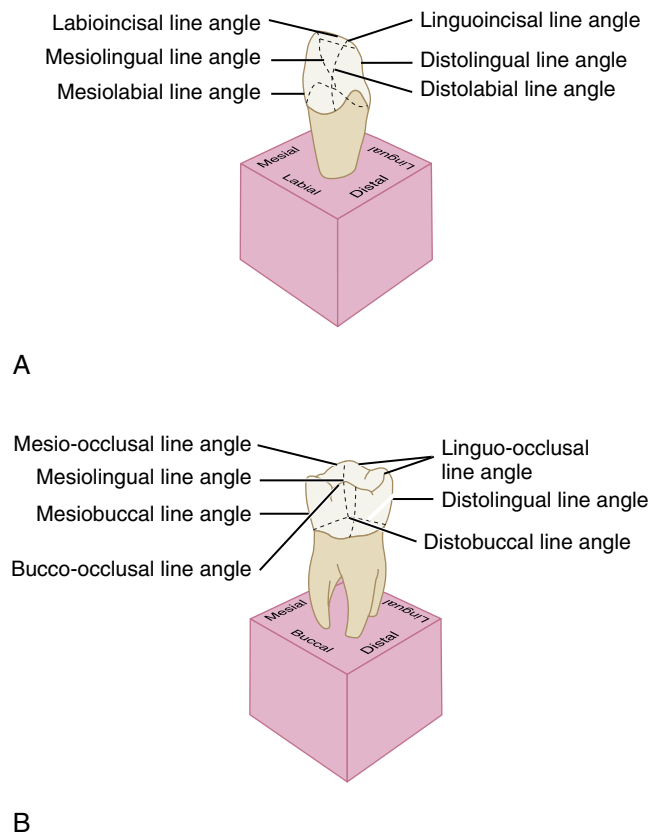
The **point angles** of the **posterior teeth** are (see Fig. 1.15B):

mesio Buccal-occlusal	mesiolinguo-occlusal
distobuccal-occlusal	distolinguo-occlusal

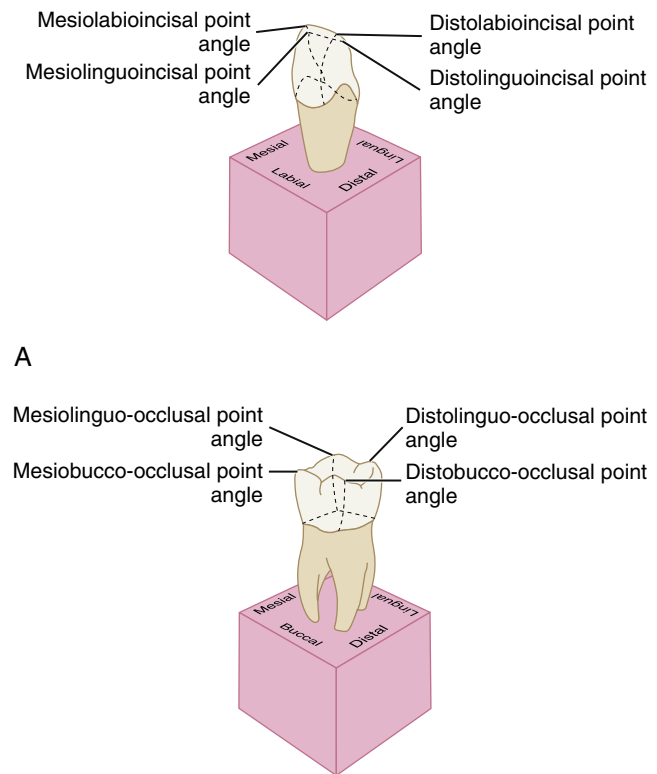
Tooth Drawing and Carving

The subject of drawing and carving of teeth is being introduced at this point because it has been found through experience that a laboratory course in tooth morphology (dissection, drawing, and carving) should be carried on simultaneously with lectures and reference work on the subject of dental anatomy. However, illustrations and instruction in tooth form drawing and carving are not included here.

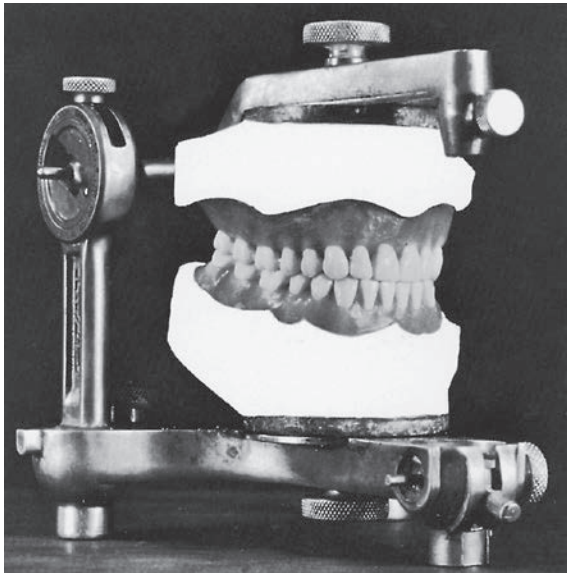
The basis for the specifications to be used for carving individual teeth is a table of average measurements for permanent teeth given by Dr. G. V. Black.⁷ However, teeth carved or drawn to these average dimensions cannot be set into place for an ideal occlusion. Therefore, for purposes of producing a complete set of articulated teeth (Figs. 1.16 to 1.18) carved from Ivorine, minor changes have been made in Dr. Black's table. In addition, carving



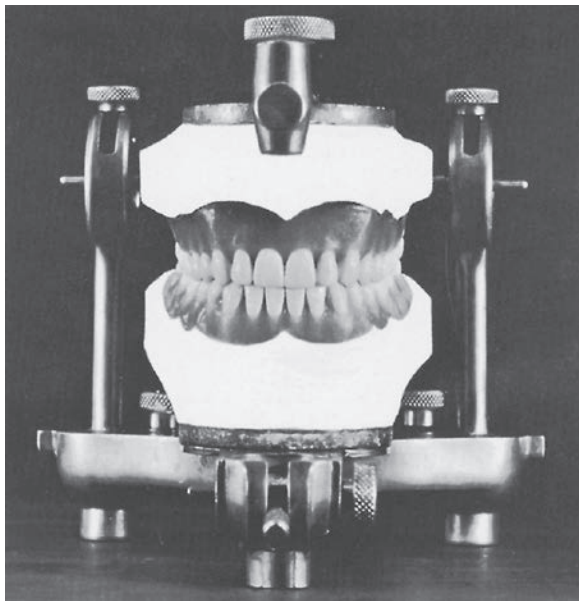
• Fig. 1.14 Line angles. (A) Anterior teeth. (B) Posterior teeth.



• Fig. 1.15 (A) Point angles on anterior teeth. (B) Point angles on posterior teeth.



• **Fig. 1.16** Carvings in Ivorine of individual teeth made according to the table of measurements (see [Table 1.1](#)). Because skulls and extracted teeth show so many variations and anomalies, an arbitrary norm for individual teeth had to be established for comparative study. Thus the 32 teeth were carved at natural size and in normal alignment and occlusion, and from the model a table of measurements was drafted.



• **Fig. 1.17** Another view of the models shown in [Fig. 1.16](#).

teeth to natural size, calibrated to tenths of a millimeter, is not practical. The adjusted measurements are shown in [Table 1.1](#). The only fractions listed in the model table are 0.5 and 0.3 mm in a few instances. Fractions are avoided whenever possible to facilitate familiarity with the table and to avoid confusion.

A table of measurements must be arbitrarily agreed on so that a reasonable comparison can be made when appraising the dimensions of any one aspect of one tooth in the mouth with that of another. It has been found that the projected table functions well in that way. For example, if the mesiodistal measurement of the

maxillary central incisor is 8.5 mm, the canine will be approximately 1 mm narrower in that measurement; if by chance the central incisor is wider or narrower than 8.5 mm, the canine measurement will correspond proportionately.

Photographs of the five aspects of each tooth—mesial, distal, labial or buccal, lingual, and incisal or occlusal—superimposed on squared-millimeter cross-section paper reduces the tooth outlines of each aspect to an accurate graph, so that it is possible to compare and record the contours ([Figs. 1.19 and 1.20](#)).

Close observation of the outlines of the squared backgrounds shows the relationship of crown to root, extent of curvatures at various points, inclination of roots, relative widths of occlusal surfaces, height of marginal ridges, contact areas, and so on.

It should be possible to draw reasonably well an outline of any aspect of any tooth in the mouth. It should be in good proportion without reference to another drawing or three-dimensional model.

For the development of skills in observation and in the restoration of lost tooth form, the following specific criteria are suggested:

1. Become so familiar with the table of measurements that it is possible to make instant comparisons mentally of the proportion of one tooth with regard to another from any aspect.
2. Learn to draw accurate outlines of any aspect of any tooth.
3. Learn to carve with precision any design one can illustrate with line drawings.

Measurement of Teeth

Readers who are not familiar with the **Boley gauge** should study its use before reading the following instructions on the application of the table of measurements.

To understand the table, let us demonstrate the calibrations as recorded and the landmarks they encompass. There are **eight calibrations** of each tooth to be remembered. These measurements are shown in the accompanying example for the maxillary central incisor (see the example included in [Table 1.1](#)).

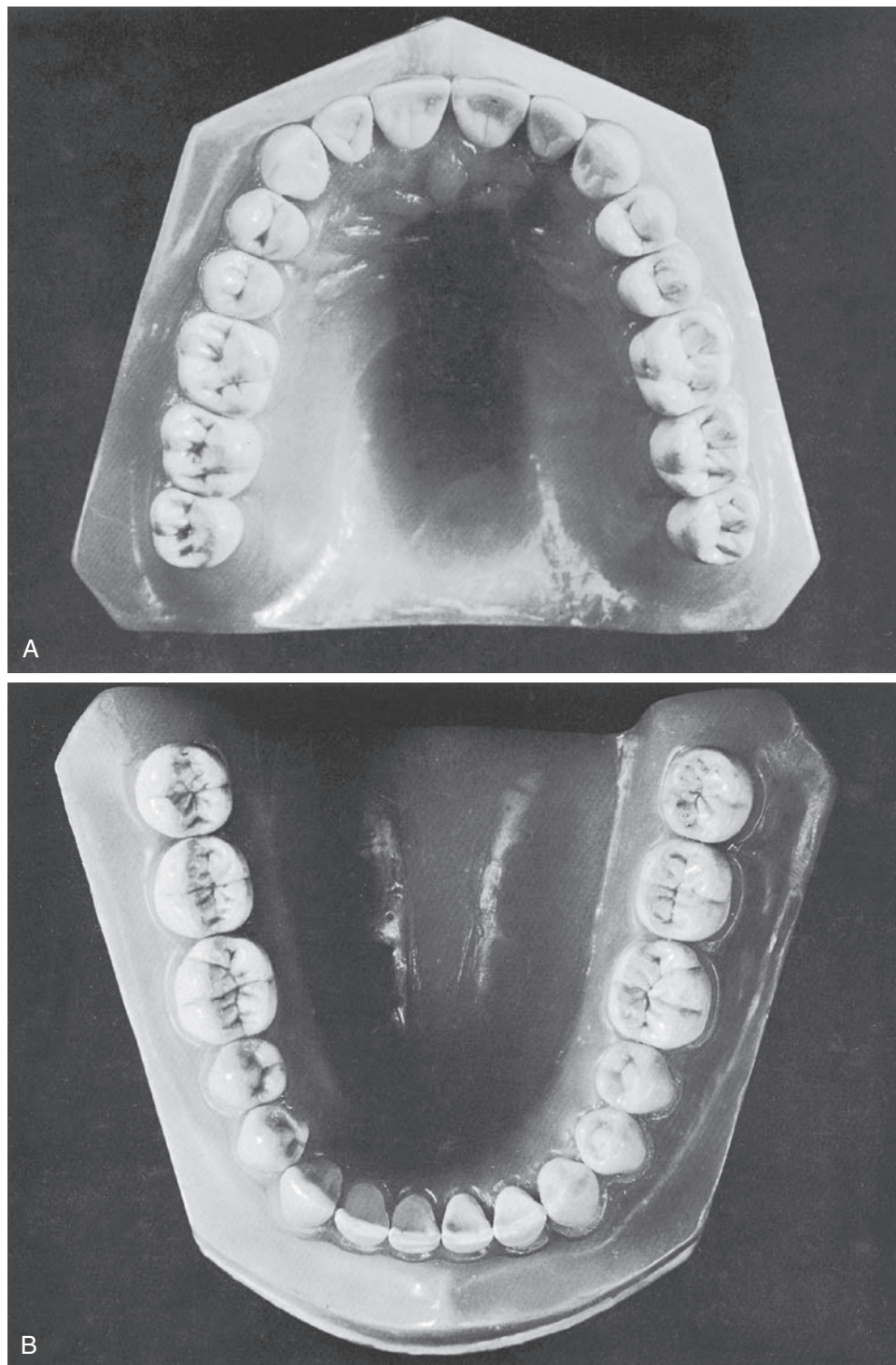
The method for measuring an anterior tooth is shown in [Box 1.1](#) ([Figs. 1.21 to 1.27](#)), and the posterior method is shown in [Box 1.2](#) ([Figs. 1.28 to 1.34](#)).

Summary

Terminology is an established basis for communication, and therefore the importance of learning the nomenclature for dental anatomy cannot be minimized. The terms used in describing the morphology of teeth are used in every aspect of dental practice.

Although there is no such thing as an established invariable norm in nature, in the study of anatomy it is necessary that there be a starting point. Therefore we must begin with an **arbitrary criterion**, accepted after experimentation and due consideration. Because restorative dentistry must approach the scientific as closely as manual dexterity will allow, models, plans, photographs, and natural specimens should be given preference over the written text on this subject.

Every curve and segment of a normal tooth has some functional basis, and it is important to reproduce them accurately. The successful clinician in dentistry or, for that matter, any designer of dental restorations should be able to mentally create pictures of the teeth from any aspect and relate those aspects of dental anatomy to function. Complete pictures can be formed only when one is familiar with the main details of tooth form.



• **Fig. 1.18** Occlusal view of the models shown in Figs. 1.16 and 1.17.