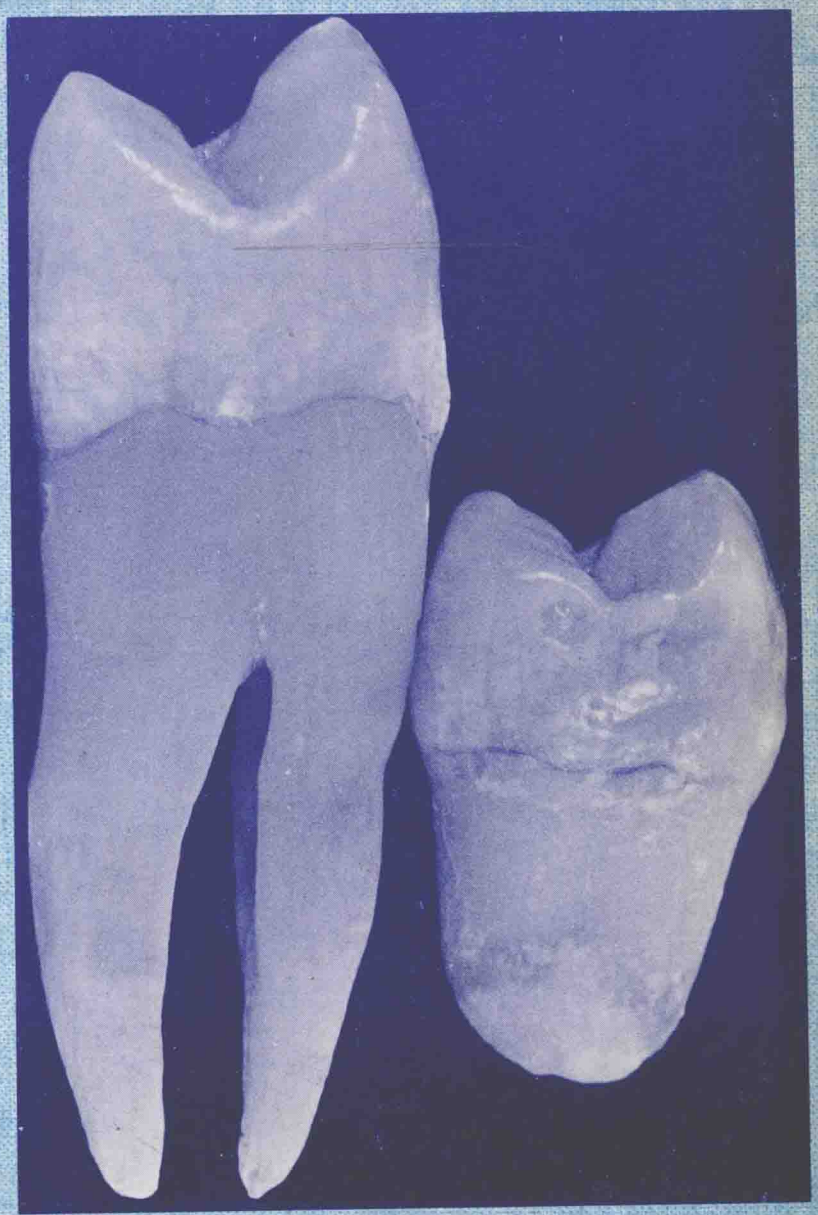
Permar's Outline for Dental Anatomy

2nd Edition



JULIAN B. WOELFEL

Permar's Outline for Dental Anatomy

2nd Edition

JULIAN B. WOELFEL, D.D.S.
Professor, Departments of Prosthodontics, Dental Materials, and Dental Hygiene. The Ohio State University College of Dentistry
Columbus, Ohio

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PERMAR'S OUTLINE FOR DENTAL ANATOMY

Preface

Permar's Outline for Dental Anatomy is intended primarily to guide students in the study of tooth morphology and to help them understand the relationship of teeth to one another and to the bones, muscles, and nerves closely associated with the dentition.

Beginning students have dissimilar backgrounds. This book is planned for those who have had no formal course in head anatomy but who have studied mammalian anatomy and are acquainted with the general structure of the head. Students with no knowledge at all of the head will need to refer to a book devoted to human anatomy.

Included are descriptions of external and internal tooth morphology, and of the skull, the temporomandibular articulation and muscles of mastication, the nerves and blood vessels associated with the teeth, and occlusion of the teeth.

Every effort needs to be made to help the student study in a way that will be time-saving and will make learning a useful and interesting experience. With this object in view this book uses brief sentences omitting unnecessary words, to give easy reference back and forth from tooth description to tooth specimen. Learning seems to progress more smoothly in this way than by merely reading descriptions of teeth, and there is less tendency for the learner to memorize, for purpose of answering quiz questions. Words and sentences that hold little meaning are soon forgotten. The outline is intended to be used in connection with lectures, discussion periods, and laboratory sessions.

I am greatly indebted to Professor Permar for teaching me much about these subjects and for her sincere friendship and our cordial associations over the years at The Ohio State University College of Dentistry. Most particularly we must not forget her thousands of hours of devotion in formulating this excellent teaching manual, personally preparing many of the specimens, and photographing most of them. It would have taken me many years to produce such an encompassing work, and my outline probably would have lacked her typical succinct, well-organized, easy-to-understand statements. I have made every effort to preserve her format in the revisions and new material I have added. Having used Permar's *Outline for Dental Anatomy* as a dental hygiene text for five years, I have developed an insight as to where additional information in the text was needed, where specific study guides would stimulate further study, and where additional illustrations and definitions would improve clarity and understanding.

I wish to thank Professor Orville Russell for revising Chapters 14 and 15, Amelia A. Boye for her several excellent new illustra-

tions, Ralph Ulbrich for assistance with photography, and especially the many dental hygiene students who have brought in fascinating tooth specimens and who have suggested a number of changes for this second edition.

I have rewritten every chapter, adding significant information and new statements, all based on personal observations of several hundred tooth specimens, diagnostic casts, and mouths. I include extensive original unpublished information that I hope will eliminate such ambiguous terms as "sometimes and generally." Most importantly, my goal has been to help the student enjoy learning about the characteristics of teeth, the jaws, and supporting perioral structures, the movement of the mandible, and the results when the teeth come together.

It has been my great pleasure to have known Professor Dorothy Permar for thirty-two years and to have had the opportunity to revise her book. It was to have been a joint project prior to her unexpected death. I am most humble in dedicating this second edition in memory of Dorothy Permar—educator, researcher, and friend—who died in 1977.

JULIAN B. WOELFEL

Columbus, Ohio

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Introduction

Dental anatomy includes the surface form of the oral cavity, the external morphology and internal composition of the individual teeth, the relationship of the teeth to one another and to the skull bones in which they are set, the joints that enable movement of the lower jaw against the upper, the muscles that bring about this movement, and the nerves and blood vessels that supply the muscles and bones and teeth.

For study of surface form of the oral cavity, tooth arrangement, and tooth relationships, you may find some of your best specimens to be the mouths of your family, friends, and classmates. With a little circumspection in asking their cooperation, you will probably find them willing to assist in your education. Remember also to observe your own teeth by looking in a mirror.

For learning tooth morphology, that is, the form of individual teeth, the best possible material is a collection of as many relatively undamaged extracted teeth as you are able to acquire. Tooth models, if available, are useful in learning the distinguishing characteristics of different kinds of teeth, but only by the study of natural teeth can you come to appreciate the variability of the dentition. This will help you develop a concept of what is normal or average.

Large numbers of nearly intact teeth are sometimes not easy to obtain. Your best source of supply may be a dentist whose clinical practice includes many extractions. If he is presented with a quart jar of formalin, he will remember his own student days and will probably be glad to put extracted teeth in the jar. Do not expect him to sort out the damaged teeth; sorting is your job.

Tooth specimens should be scraped clean with a knife and immersed for days or weeks in 10% buffered neutral formalin.* Soaking for several hours in hydrogen peroxide before

*Buffered neutral formalin (pH 7)

Formalin, full strength (40% formaldehyde)	100.0 ml
Distilled water	900.0 ml
Sodium phosphate dibasic (anhydrous)	6.5 gm
Sodium phosphate monobasic	4.0 gm

Or, buffer a mixture of 9 parts water and 1 part full strength formalin by adding a few marble chips to prevent the accumulation of formic acid.

scraping is helpful. After scraping to remove debris, calculus, and tissue, tooth specimens can be further cleansed by soaking for 20 minutes in 4 ounces of a household bleach containing 2 tablespoons of Calgon (a water softener). Once cleaned, they should be stored for preservation in fresh 10% neutral formalin.

A good way to ruin your valuable tooth specimens is to preserve them in formalin that has not been buffered (the subsequently formed formic acid will dissolve the tooth enamel), or to let the specimens dry out (they will become fragile and break).

This book is composed in the form of an outline rather than a narrative to give you easier and quicker reference in your study of the morphology of teeth and the relationship of teeth to their surrounding and supporting tissues. The best method of study with the outline is to sort out a number of teeth of the type you are going to examine—for example, maxillary central and lateral incisors—and place them and the outline before you on a table. Read the outline, and step by step identify on your several specimens each feature as it is described. Notice the anatomic variations in teeth of the same type. With the tip of your finger, feel the curvatures of the tooth surfaces as you read—sometimes we see as much with our fingers as with our eyes. Working in this way you will find that the descriptions make sense and that you retain the information with little effort. Even if set forth in the most lively language, a detailed description of the morphology of 16 teeth read as you would read a history book or a mystery story is more frustrating than conducive to learning. But if you become interested in the many consistencies and inconsistencies of tooth anatomy, the study can become a means not only to a sound professional background, but also to an interesting hobby. You may find it helpful to imagine how each tooth fits against the tooth in the opposing arch when biting or chewing. When study casts are available, you can find worn places (facets) where opposing teeth have rubbed together during function.

One way to reinforce learning of tooth morphology and at the same time develop manual skill is to draw and carve teeth. To draw a tooth accurately (making a poor drawing is of little value) you must examine the tooth until you really *see what you are looking at* and until you can visualize the relationship of one characteristic to another. To learn to *see what you are looking at* is the objective.

If you carve a tooth from a block of wax, you learn to see the tooth in a third dimension. Also, carving is a manual skill, and this kind of skill is a necessity in almost any phase of dentistry. In the carving exercise you achieve three objectives: you learn the form of the tooth, you learn to see the tooth in three dimensions, and you learn to reproduce accurately what you see. You learn to make your fingers create the image that is in your mind.* Later on one of your duties may be to reproduce portions of a tooth with a restorative material such as composite or amalgam. Reproduction of correct anatomic form will be most important to both you and to the patient.

Internal morphology of teeth is also important. Teeth have a hollow center, the pulp cavity, which contains tooth pulp. Tooth pulp is made up of several kinds of connective tissue cells and intercellular substance, throughout which are distributed blood vessels and nerves. Microscopic anatomy of tooth pulp tissue is usually studied in a course in oral histology.

Pulp cavities—their size, shape, and variations—are best studied by the interesting operation of grinding off one side of an extracted tooth. A dental lathe equipped with a *fine-grained* abrasive wheel about 3 inches in diameter and ½ inch thick can be used to remove any part of the tooth. Simply decide which surface is to be removed, hold the tooth securely in your fingers, and apply this surface firmly to the *flat surface* of the abrasive wheel. Operating the lathe at a fairly high speed is less apt to flip the specimen from your fingers than operating it at a low speed. If you can devise an arrangement by which a small stream of water is run onto the surface of the wheel as the tooth is ground, you will eliminate flying

*Directions for drawing and carving teeth are to be found in Chapter 18.

tooth dust and a bad odor of hot tooth tissue. If such an arrangement is not feasible, keep the tooth moist by frequently dipping the surface being ground in water or by dropping water onto the wheel with a medicine dropper. Look often at the tooth surface you are cutting and adjust your applied pressure to attain the plane in which you wish the tooth to be cut.

As you frequently examine the cut surface of the tooth, watch for pits and fissures in the enamel (see the description of occlusal surfaces of posterior teeth) and watch carefully the configuration of any carious lesion as you see it at different levels of grinding. This can be a fascinating pastime as well as a valuable part of your education. You may want to preserve your ground tooth specimens for future examination when, in your course in oral histology, you study the histology of the hard tooth tissues. Extracted teeth should be kept moist or wet all the time.

For the study of head anatomy it will be much to your advantage to have a prepared human dry skull available. More is learned by holding the skull in your hands and tracing the bone surfaces with your fingers than by energetic attempts to memorize unaccustomed words of uncertain meaning.

Among students who undertake the study of dental anatomy preparatory background differs considerably. If, in your preparatory courses, you have not studied head anatomy, you will need to obtain a book on human anatomy and read about the skull, muscles, nerves, and blood vessels of the head. Study your prepared skull in the same way you study individual teeth: locate the larger bones, and pay particular attention to the maxillary and mandibular bones. Examine the bilateral articulation of the mandible with the cranium (the temporomandibular articulation) and read the outline carefully. The illustrations of the joint should help you to visualize its construction in living persons and the movement of the joint in function.

Examine as many skulls as possible and notice the variation in the size and shape of the bones. Pay particular attention to the bones of the upper and lower jaws. You may well conclude that variability is consistency.

Examine skulls also for the occlusion of the teeth, i.e., the contact of the maxillary and mandibular teeth when the mandible is in different functional positions. It is well to keep in mind, if you see some unexplainable tooth relationships, that sometimes in prepared skulls missing or damaged teeth have been replaced by teeth from other sources. This substitution makes little difference in the study of skull anatomy unless you happen to be studying occlusion.

Judicious note-making during your examination of a number of any kind of specimen will bring into focus features characteristic of the group. For instance, in examining a certain type of tooth, list the characteristics you find constant in all of the teeth in that group, and the characteristics that are constant in many but that vary in a few specimens. And make record of teeth with characteristics so greatly different from all of the other teeth that you regard those teeth as anomalies.

AGAIN YOU ARE URGED TO HAVE EXTRACTED TOOTH SPECIMENS BEFORE YOU AS YOU STUDY THE MORPHOLOGY OF TEETH. THIS METHOD IS THE BEST ROAD, PERHAPS THE ONLY ROAD, TO RAPID SUCCESS.

1

The Appearance of the Oral Cavity

Look into someone's mouth as you read this description and locate each structure mentioned. Use a tongue depressor or a mouth mirror to retract the lips and cheeks.

UPON LOOKING INTO THE ORAL CAVITY you can see

1. Lips (entrance)
2. Teeth
3. Tongue
4. Floor of mouth
5. Roof of mouth
   a. hard palate
   b. soft palate
6. Cheeks
7. Gingiva
8. Vestibules
9. Salivary duct openings
10. Oral mucous membranes

LIPS (Fig. 1-1)

The lips are redder in younger persons than in older ones. In some individuals the lip color is reddish brown due to the presence of brown pigment.

UPPER LIP: *Tubercle*—The small rounded nodule of tissue in the center of the lowest part of the upper lip.

Philtrum—The depression running from the tubercle to the nostrils.

Nasolabial groove—The groove running diagonally downward on each side of the nostril toward the corner of the lip.

COMMISSURE: The corner of the mouth where the upper and lower lips meet.

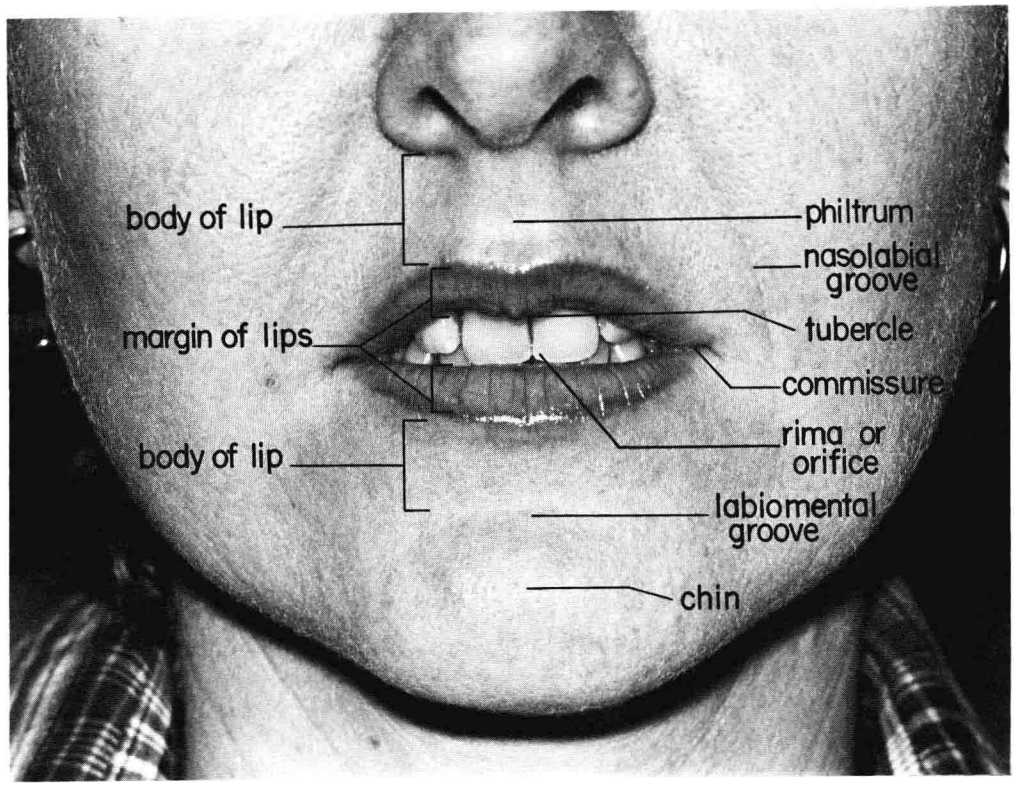

Fig. 1-1. Surface anatomy of structures in lower half of face. The margin of the lip is sometimes called the vermilion border. The wet-dry line does not show because the margins were moistened by the tongue in order to photograph well.

WET LINE (or wet-dry line): The junction or division between the inner more smooth and outer red portion of the lips which is usually dry. The wet line is located only a few millimeters back from the skin in the red zone of the lips.

LABIOMENTAL GROOVE: The horizontal groove under the lower lip which emphasizes the chin.

TEETH

There are two *dental arches* (rows of teeth): maxillary or upper and mandibular or lower (Figs. 1-2, 1-3).

Number of teeth:

Number depends on the age of the individual, normal development of the teeth, and number of teeth lost by disease, accident, or for orthodontic treatment.

The complete primary dentition (baby teeth) consists of 20 teeth. Children between $2\frac{1}{2}$ to $5\frac{1}{2}$ years of age will usually have 20 teeth (all primary dentition).

From approximately $5\frac{3}{4}$ to 12 years of age a *mixed dentition* with some primary and some permanent teeth is present. The mixed dentition of a 6 year old would have 24 teeth and by 12 years of age there would be 28 teeth.

The complete permanent dentition consists of 32 teeth, including the four third

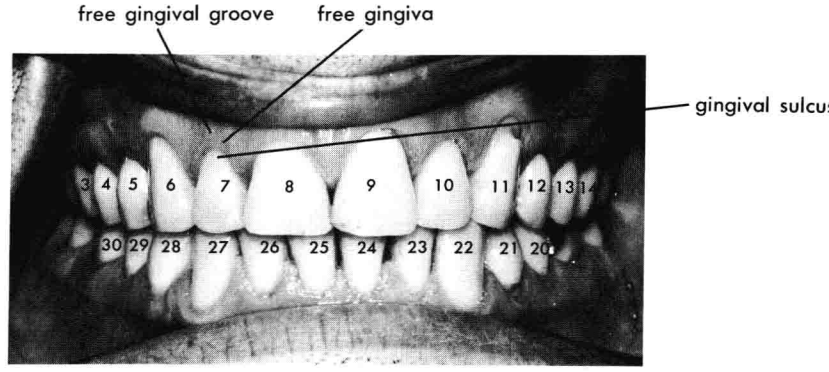

Fig. 1-2. Maxillary and mandibular teeth of the permanent dentition are in occlusion; the labial surfaces of the anterior teeth and the buccal surfaces of the posterior teeth are seen. The gingiva surrounds the teeth and forms the interdental papillae between them. The mandibular vestibule is exposed. Notice how each tooth is in contact with the adjacent teeth; how the maxillary arch overlaps the mandibular arch; and how the greater width of the maxillary central incisors causes each of them to overlap not only the mandibular central incisor but also half of the mandibular lateral incisor. (See Chapter 17 on occlusion.) Notice the cervical erosion on tooth number 11. The spaces between teeth number 24 and number 25 and between teeth number 23 and number 24 are called diastemas.

molars which come in during the late teens. Immediately posterior to the maxillary second molar is a bulge of the alveolar ridge and tissue named the *maxillary tuberosity*. A similar less prominent elevation of tissue distal to the mandibular second molar is the *retromolar pad*.

TONGUE

The tongue is a broad flat organ composed of muscle fibers and glands. Its shape changes with functional movement.

The *dorsum* (top side) of the tongue is grayish red and is rough. It is covered by two kinds of papillae: *filiform papillae* which are abundant, fine, and hairlike, covering

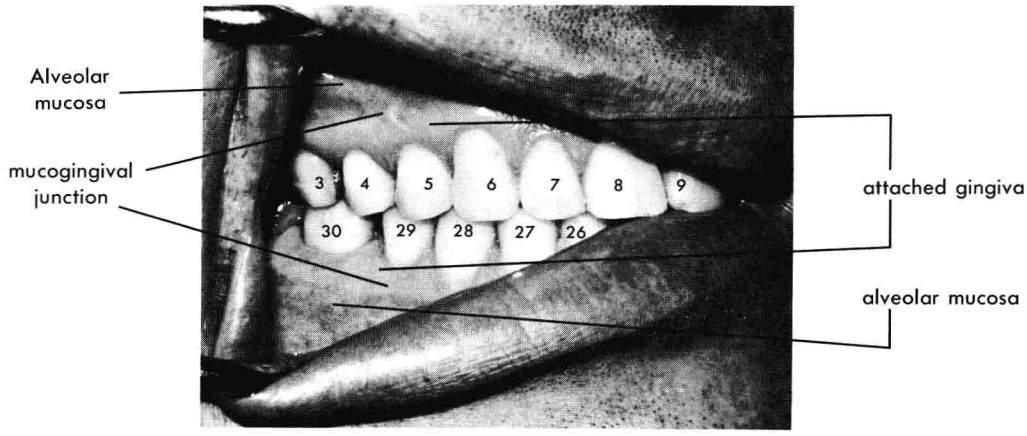

Fig. 1-3. The subject is the same as in Figure 1-2, but here the right cheek is drawn back. Notice arrangement of the maxillary teeth relative to the mandibular teeth: each maxillary tooth overlaps two mandibular teeth. There is a clear line between the light-colored gingiva and the darker alveolar mucosa, the mucogingival junction. (See Fig. 13-6). The attached gingiva is stippled above tooth number 7. Notice the metal restorations on teeth number 3 and number 30.

about two-thirds of the dorsal surface; and the larger, more sparse *fungiform papillae* which are easy to locate by the round mushroom shape and red color. Eight to 12 large *circumvallate papillae* form a V-shaped row on the dorsum at the posterior part.

Foliate papillae are found on the lateral surfaces of the tongue in the posterior one-third.

The ventral or undersurface of the tongue is shiny, and blood vessels are visible.

The *lingual frenum* (frē'num) is a thin sheet of tissue which attaches the center of the undersurface of the tongue to the floor of the mouth. Raise your tongue and watch how this cordlike structure limits the amount of tongue movement.

FLOOR OF THE MOUTH

Beneath the tongue are bilateral bulges caused by the presence there of large salivary glands.

Sublingual folds, called the *plica sublingualis* (*plī'kȧ sub līng guȧl ĭs*), extend anteriorly on each side from the first molar to the *lingual frenum* where the broad underside of the tongue is attached to the floor of the mouth. Along these folds are openings of ducts from underlying sublingual salivary glands located in this region. The sublingual glands secrete purely mucous (ropy type) saliva, producing only 5 to 8% of our saliva.[1]

At the center line between the right and left sublingual folds is a pair of papillae (bulges) each with an opening from ducts of salivary glands, called *Wharton's duct openings* (sublingual caruncles). Wharton's ducts drain the more posteriorly located submandibular glands which produce about two-thirds of our saliva.[1] Their secretions are primarily serous.

The floor of the mouth is shiny, and some large blood vessels may be seen near the surface.

A person will normally secrete over a pint of saliva during 24 hours (300 ml between meals, 300 ml while eating, and only 20 ml while sleeping) based on averages from 600 people.[1]

ROOF OF THE MOUTH

Hard palate—The anterior part of the roof of the mouth.

Soft palate—The posterior part of the roof of the mouth.

Vibrating line—The junction between the hard and soft palate.

The Hard Palate (Fig. 1-4)

The color is grayish red.

Incisive papilla is the small rounded elevation of tissue on the midline just behind or lingual to the central incisors.

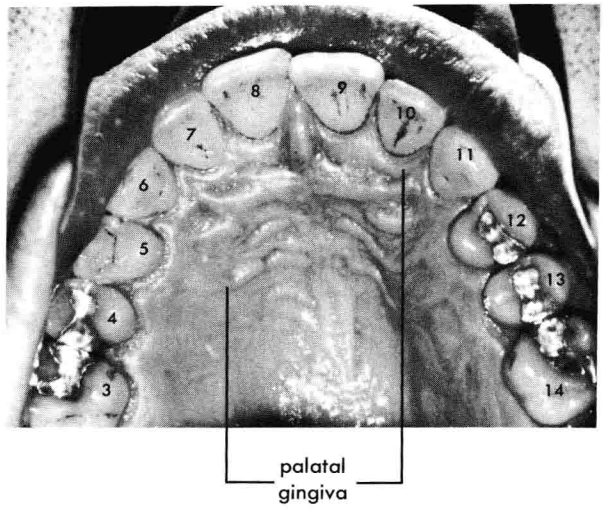

Fig. 1-4. The hard palate is bordered by the maxillary dental arch. The teeth in the picture are, on either side of the arch, the central incisor, lateral incisor, canine, first premolar, second premolar, and first molar. (See Fig. 2-1.) The posterior parts of the arch, and the soft palate, are not in the picture. The *palatine rugae* are prominent, as is the *incisive papilla* (the enlargement between the right and left central incisors). The *palatine raphe* is seen but is not conspicuous in this subject. In some mouths this raphe is more ridge-like, extending anteroposteriorly in the center of the hard palate, and is readily distinguished. Can you name each tooth and list the surfaces that have been restored with metal fillings? Notice the lingual pits on teeth number 3 and number 7.

Palatine raphe (pronounced *rā'fē*) is the slightly elevated center line running anteroposteriorly in the hard palate. This is the place of union of the right and left maxillae. The bone is immediately under the mucosa along this line.

The sides of the hard palate are less hard than the palatine raphe because there is fat or salivary gland tissue beneath the surface tissue.

Palatine rugae (plural, pronounced *roo'jē*; singular is *ruga*, *roo'ga*) are more distinct in young persons than in older persons. They are a series of elevations, or wrinkles, running from side to side behind the maxillary anterior teeth (Fig. 1-4).

The end of the hard palate is opposite the third molars.

The Soft Palate

The soft palate is sometimes redder than the hard palate due to its somewhat increased vascularity. Its anterior border extends between the right and left third molars.

There is no bone beneath the surface of the soft palate. (Say *AHHHH* and look.) The hinged place or the place where you observe the motion beginning is the vibrating line.

Uvula (*u'vu la*. Both *u*'s are pronounced like the *u* in *use*) is a small fleshy structure hanging from the center of the posterior border of the soft palate.

The arches on either side of the uvula are the anterior and posterior palatine pillars or arches.

Behind the soft palate is the oropharynx which leads to the esophagus. The arched opening from the oral cavity into the pharynx is the *fauces*.

Laterally on each side is a curtain-like connection between the mandible and maxilla named the *pterygomandibular raphe*. This is easy to see when the mouth is opened wide as this action stretches this raphe.

Fovea palatinae (*fō'vė ē păl'ā tīne'ē;* L. *fovea,* pit) are a pair of pits in the soft palate located on either side of the center line near but posterior to the vibrating line. They are openings of ducts of minor palatine glands.

CHEEKS

The lining of the inside of the cheeks is shiny, and in spots it is rough. Notice a white line running posteriorly on each side at the level where the upper and lower teeth come together. This is called the linea alba buccalis.

Parotid papilla is a round elevation of tissue between first and second molars just below the occlusal plane covering the duct openings on either side. The duct from the parotid gland is named Stensen's duct. The parotid glands located in front of the ear produce 23 to 33% of our saliva (serous type).[1]

Fordyce's spots are yellow and may be conspicuous inside the lips or buccal mucosa especially inside the cheeks just posterior to the corner of the mouth. They are small yellowish elevations produced by the presence of sebaceous or sweat glands—glands of a type otherwise found only in the skin on the outside of the body. Their presence here is often said to be the result of fusion of the upper and lower parts of the cheek during embryonic development. However, such glands have also been found on other parts of the oral mucosa.

GINGIVA

Definition: The soft tissue which surrounds the cervical part of the teeth and is firmly attached to the teeth and to the bone in which the teeth are set (Figs. 1-2 and 1-4).

The gingiva is grayish and stippled in persons with light pigmentation. In persons with dark coloring of the hair and skin, the gingiva may be brown or spotted with brown (melanin pigmentation).

The *attached gingiva* is the grey to light pink gingiva surrounding all teeth except for the free gingiva.

Mucogingival junction is a scalloped line between the attached gingiva and the redder *alveolar mucosa* on the facial side just below (lower jaw) or above (upper jaw) it.

Alveolar mucosa is a darker pink or red in color with a more delicate surface just above the mucogingival junction in the maxillary arch and just below this scalloped line in the mandibular arch.

The *gingival margin* is the occlusal (incisal) border of the gingiva.

The *free gingiva* is the gingiva surrounding each tooth from the gingival margin to the depth of the gingival crevice or sulcus where floss or a sulcular brush will fit.

The gingival tissue between the teeth is called the *interdental papilla* (both free and attached gingiva).

Each of these zones of gingiva is clearly shown in Figure 13-6.

VESTIBULE

The pocket-like space between the cheek or lip on one side and the teeth and gingiva of the maxilla or mandible on the other side is called a *vestibule* (maxillary or mandibular) (Fig. 1-3). You can insert your finger into this space. Also the tip of your tongue can reach into each vestibule.

The *labial frenum* is the thin sheet of tissue that attaches the center of the lip (upper and lower) to the mucosa covering the jaw between the central incisors.

The *buccal frenum,* in the area of the premolars (maxillary and mandibular), loosely attaches the cheek to the mucosa of the jaw. These frenums may be seen by pulling the lower lip out and down, and the upper lip out and up. Our facial muscles move the buccal frenums forward and backward and upward and downward in eating to help place our food back over the chewing surfaces of our teeth for further reduction prior to swallowing.

ORAL MUCOUS MEMBRANE (ORAL MUCOSA)

A *mucous membrane* lines any body cavity that opens to the outside of the body. The *oral mucous membrane* lines the oral cavity. It resembles the skin on the outside of the body, except that it is more delicate in structure than the skin.

The mucosa of the mouth is a sturdy type of mucous membrane, and in the areas in which it gets most wear it is most sturdy, e.g., the roof of the mouth and the gingiva. Its appearance in these areas of greater wear is grayish rather than red, as it is in the floor of the mouth and cheeks where it is more protected.

Test your newly acquired knowledge now by playing the match-up game below:

Study Guide on Oral Anatomic Landmarks

Place appropriate letter on line on left.

_____ 1. Dorsum of tongue	a. Mouth
_____ 2. Hard palate	b. Dark pigment on gingiva of blacks
_____ 3. Pharynx	c. In floor of mouth where plica sublingualis meet
_____ 4. Elevated midline of hard palate	d. Underside of tongue
_____ 5. Stensen's duct	e. Has rugae
_____ 6. Alveolar mucosa	f. Top side of tongue
_____ 7. Fordyce's spots	g. Sebaceous glands on inside of cheek
_____ 8. Melanin	h. Interdental papillae
_____ 9. Gingiva between tooth numbers 11 and 12 or 19 and 20	i. Opens on inside of cheek near maxillary 1st molar
_____ 10. Enlargement between tooth numbers 8 and 9 on the palatal side	j. Palatine raphe
_____ 11. Vibrating line	k. Attaches lip to mucosa covering jaw (upper and lower)
_____ 12. Wharton's duct openings	l. Behind soft palate
_____ 13. Labial frenum	m. Incisive papilla
_____ 14. Ventral surface of tongue	n. Lines floor of vestibule
	o. Found between hard and soft palate
	p. Ridge of bone lingual to mandibular