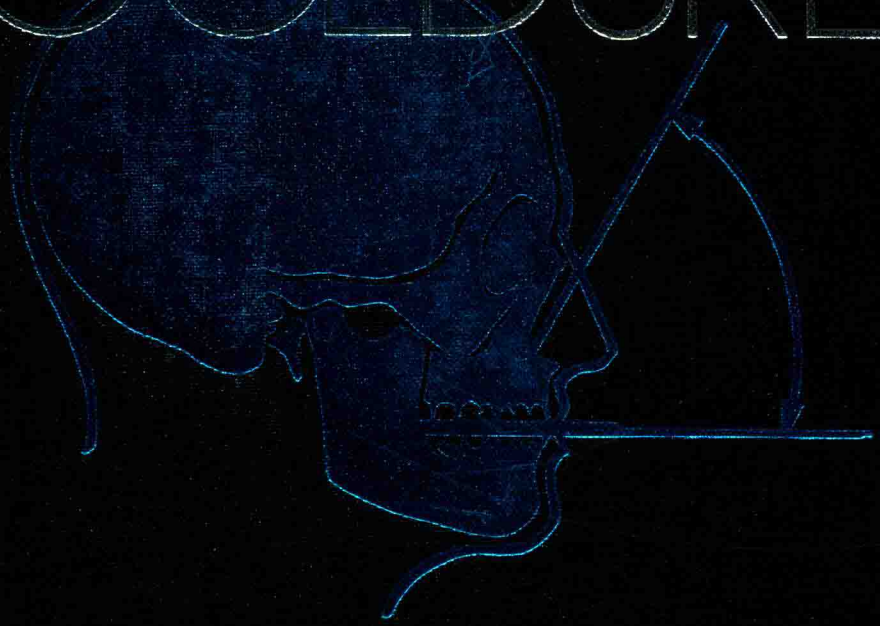
VOLUME TWO

MERRILL'S ATLAS OF

RADIOGRAPHIC POSITIONS and RADIOLOGIC PROCEDURES



Philip W. Ballinger

SEVENTH EDITION

VOLUME TWO

MERRILL'S ATLAS OF RADIOGRAPHIC POSITIONS and RADIOLOGIC PROCEDURES

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PREFACE

Hardly is the ink dry on one edition when new knowledge, different procedures, and technological advancements dictate that the revision process begin. Such was the case with this edition of *Merrill's Atlas of Radiographic Positions and Radiologic Procedures*.

One of the more noticeable changes can be attributed to the Twelfth International Congress of Anatomists, which met in London in 1985. Substantial alterations of nomenclature were adopted; these results were published in the 1989 sixth edition of *Nomina Anatomica,* the third edition of *Nomina Histologica,* and the third edition of *Nomina Embryologica*. Because the terminology authorized by the International Congress is the standard terminology for anatomy, this seventh edition of *Merrill's Atlas* reflects these nomenclature changes.

To make the transition to the new anatomic terminology easier, the decision was made to list the new term first and the older term parenthetically. An example of the change is that of the carpal navicular; the accepted name is the scaphoid, so it is printed in the text as *scaphoid (navicular)*. Some reviewers of the early manuscript did not like all of the terminology changes, but we as health care professionals must adopt the terminology used in anatomy textbooks and taught to radiography students, medical students, and residents in radiology. I personally prefer *odontoid process* to the term *dens,* and *extremity* to *limb,* but in the new edition these examples are printed as *dens (odontoid process),* and *limb (extremity)*. To assist the reader of *Merrill's Atlas* in identifying which anatomic terms have changed since the sixth edition, a summary listing the new and old terms is printed on the inside cover.

Other changes were designed to make using the text easier. The phase of patient respiration has been consistently placed in this edition. *Respiration* instructions have been included just before the central ray for those procedures involving the head and torso. For all chapters involving radiography of the head, *italics* were added to the primary positioning landmarks to help the user to quickly identify the positioning lines and points needed to accurately position the patient. The terms *position* and *projection* have been changed to reflect the terminology adopted by The American Registry of Radiologic Technologists. Descriptions of all positioning terms are included in Chapter 3 on p. 43 to 50, including summary Table 3-2 on p. 45. The entrance and exit points for the central ray were expanded and clarified to more precisely identify the centering points when positioning the patient. Similarly, some centering points were slightly changed to reflect the anatomical centering points of the body part, which are required when using positive beam limitation equipment. Other changes include placing the running heads on the edges of the pages. This makes locating a chapter or a specific position much easier.

The organization of the book remains essentially unchanged; Volumes 1 and 2 contain the radiologic procedural examinations, and Volume 3 contains descriptions of the radiology specialties. This organization was planned so, as an option, a student radiographer might purchase Volume 1 for the first term in the educational program, Volume 2 for the second educational term, and Volume 3 during the second year of professional radiography education.

Two entirely new chapters were added to Volume 3: Digital Subtraction Angiography and Computed Radiography. In addition, all chapters received substantive revisions with the addition of new illustrations and text.

Before, during, and after revising the textbook, many reviewers made significant contributions by offering suggestions for clarifying the information for the reader. Grateful appreciation is extended to three radiologists, Javier Beltran, M.D., Jerome J. Cunningham, M.D., and James Jerele, D.O., who reviewed selected chapters and offered suggestions for improvement. Several technologists devoted extensive time and effort in reviewing new chapters and new material and, in general, offering suggestions for improvement. Thanks and my true appreciation are extended to Michael W. Drafke, M.S., R.T. (R), from the College of DuPage in Glen Ellyn, Illinois; Eugene D. Frank, B.S., R.T. (R), FASRT, from the Mayo Clinic and Foundation in Rochester, Minnesota; Michael L. Fugate, M.Ed., R.T. (R) from Southwest Virginia Community College in Richlands, Virginia; Bruce W. Long, M.S., R.T.(R) from the Indiana University School of Medicine in Indianapolis, Indiana; Kenneth Roszel, B.S., R.T., from Geisinger Medical Center in Danville, Pennsylvania; Jeffrey L. Rowe, M.S., R.T.(R), from Muskingum Area Technical College in Zanesville, Ohio; Dennis Spragg, M.S.Ed., R.T.(R), from Lima Technical College in Lima, Ohio; and Anton R. Zembrod, M.Ed., R.T.(R) of Wichita Falls, Texas. I also want to thank Professor Spragg for his evaluation of the material from *Merrill's Atlas* that was published in the first edition of the *Pocket Guide to Radiography* published by Mosby-Year Book, Inc. in 1989. Mark Smith, R.T. and Debra Saunders, R.T., colleagues and graduate students at The Ohio State University, assisted me by critiquing manuscript, reviewing new material, assisting in obtaining new radiographs, proofreading manuscript, and responding to multiple requests for assistance. Your work was appreciated, and I gained a great deal of respect for each of you. I'm sure your futures will be bright.

Literally thousands of journal articles must be searched for and reviewed in revising each edition. Terry Kempton, R.T. devoted extensive time and effort to search for, locate, and review thousands of journal articles. As a result, over 1300 articles written by over 2800 authors were reviewed and added to this edition in the bibliographic sections of all three volumes. The task was extremely demanding and would not have been possible without Ms. Kempton's help.

Two anatomists at The Ohio State University assisted greatly in revising this edition. Margaret Hines, Ph.D re-

viewed the anatomy sections following the publication of the 1989 editon of *Nomina Anatomica*. Dr. Hines' comments were extremely valuable and timely in making the changes in terminology possible. Her continual support and assistance are truly appreciated. Professor John Chidley also reviewed the anatomy sections and offered suggestions for changes.

Eva James, R.T., reviewed the comments of the anatomists and those received from users, synthesized them, compared them with *Nomina Anatomica,* and organized the anatomy sections of the chapters for consistency and clarity. In addition, Ms. James reviewed the final manuscript and prepared a summary of the anatomic terms that have changed from the previous edition.

Sincere thanks are extended to Julie Gilhousen, R.T.(R)(N) from Picker International, Inc. for her cooperation in arranging for the use of the radiographic equipment needed to produce new photographic illustrations. Picker International, Inc. has demonstrated strong support for this *Atlas* through all seven editions and that support is truly appreciated.

Although every effort has been made to ensure accuracy and consistency of information, an occasional mistake escapes. When such occurs, you can assist me by marking the error on a photocopy of the page and mailing it directly to me. Suggestions for improvement are also welcome, for it is only with the assistance of concerned professionals that the text is strengthened.

This *Atlas* requires extensive visual support and without the professional staff of the medical illustrators, medical photographers, and the concerned staff of the Biomedical Communications Division in the School of Allied Medical Professions and The Ohio State University, the illustrations printed in this textbook would not be of such high quality. Particular thanks are extended to chief photographer Robert Jones for his patience and cooperation in shooting, printing, and reprinting the illustrations to show just what is desired. Thanks also to Mr. Harry Condry and Mr. Matthew Eppley for their responding to my many, sometimes impossible, requests.

Sincere thanks are extended to scores of individuals (R.T.s, students, and physicians) who assisted by locating radiographs for this edition. As is the custom, whenever a radiograph is printed in the *Atlas,* the name of the individual supplying the original radiograph is printed adjacent to the image. Unfortunately there were a few radiographs I was not able to print because they were duplicates. Thanks again to all who assisted by supplying illustrations of excellent quality for this edition.

Sincere thanks are extended to Eileen Buckholz who has served as secretary to the Radiologic Technology Division at The Ohio State University (and manager of my schedule) for several years. Her ability to assist the faculty and students, get me to classes with students, attend university meetings, respond to phone calls, and many other tasks while keeping track of me is truly appreciated. Thanks again, Eileen, for all your help.

To David Culverwell, Peggy Fagen, Christi Mangold, Cecilia Reilly, Elaine Steinborn, Mary Stueck, and the entire professional staff of Mosby-Year Book, Inc., I enjoyed working with you in our mutual quest to produce a quality textbook. Although some of the deadlines were a little tight, we generally made them.

Without the total support of my family this project would not have been possible. To my father-in-law, L. Neil Hathaway, thanks for your understanding and encouragement. I also thank my parents, D.W. and Mildred Ballinger, for their love and encouragement demonstrated throughout my career and their continuing support and assistance. They are always there when they are needed and I apologize for taking that for granted. To my wife, Nancy, loving appreciation is extended for her understanding and assistance. In addition to being an understanding wife (well, most of the time), my multiple requests for her help have generally been answered. Many times the family schedule has been revised or something rescheduled because I was out of town or "just had to work." Thanks for your love and support over the years. My son, Eric, and daughter, Monica, are relatively understanding of the neverending revision process. I apologize for the many times I should have been doing things to assist and support them, but was instead working on the book or attending a professional meeting. Over the years Eric and Monica have learned to stop asking, "Is the book done yet?" because they know that as soon as it is complete, it and other projects will compete for my attention. Eric and Monica, I love you and appreciate your patience. I only wish that sometimes when you see my travel schedule posted on the refrigerator door, instead of asking, "Now where are you going?" you'd ask, "When will you be back?"

Philip W. Ballinger

Columbus, Ohio

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Chapter 14

MOUTH AND SALIVARY GLANDS

Mouth

The *mouth* (Fig. 14-1) is the first division of the digestive system. It encloses the dental arches and receives the saliva secreted by the salivary glands. The cavity of the mouth is divided into (1) the *oral vestibule,* the space between the teeth and the cheeks, and (2) the *oral cavity,* or *mouth proper,* the space within the dental arches. The roof of the oral cavity is formed by the hard and soft palates. The floor is formed principally by the tongue, and it communicates with the pharynx posteriorly by an aperture termed the *faucial isthmus*.

The vault of the *hard palate* is formed by the horizontal plates of the maxillae and palatine bones. The anterior and lateral boundaries are formed by the inner wall of the maxillary alveolar processes, which extend superiorly and medially to blend with the horizontal processes. The height of the hard palate varies considerably, and it determines the angulation of the inner surface of the alveolar process. The angle is less when the palate is high and greater when it is low.

The *soft palate (velum)* begins behind the last molar and is suspended from the posterior border of the hard palate. Highly sensitive to touch, the soft palate is a movable musculomembranous structure, and it functions chiefly as a partial septum between the mouth and the pharynx. At the center of the inferior border, the soft palate is prolonged into a small, pendulous process called the *uvula*. On each side of the uvula two arched folds extend laterally and inferiorly. The anterior pair of arches, which form the faucial isthmus, project forward to the sides of the base of the tongue. The posterior pair of arches project posteriorly to blend with the posterolateral walls of the pharynx. The triangular space between the anterior and the posterior arches is occupied by the palatine tonsil.

The *tongue* (Figs. 14-1 and 14-2) is situated in the floor of the oral cavity, with its base directed posteriorly and its apex directed anteriorly. The tongue is freely movable, composed of numerous muscles, and covered with mucous membrane that varies in character in the different regions of the organ. The extrinsic muscles of the tongue form the greater part of the oral floor. The mucous membrane covering the undersurface of the tongue is reflected laterally over the remainder of the floor to the gums. This part of the floor lies under the free anterior and lateral portions of the tongue and is called the *sublingual space*. Posterior movement of the free anterior part of the tongue is restricted by a median vertical band, or fold, of mucous membrane called the frenulum of the tongue *(frenulum linguae),* which extends between the undersurface of the tongue and the sublingual space. On each side of the frenulum, extending around the outer limits of the sublingual space and over the underlying salivary glands, the mucous membrane is elevated into a crest-like ridge called the sublingual fold *(plica sublingualis)*. In the relaxed state the two folds (plicae) are quite prominent and are in contact with the gums.

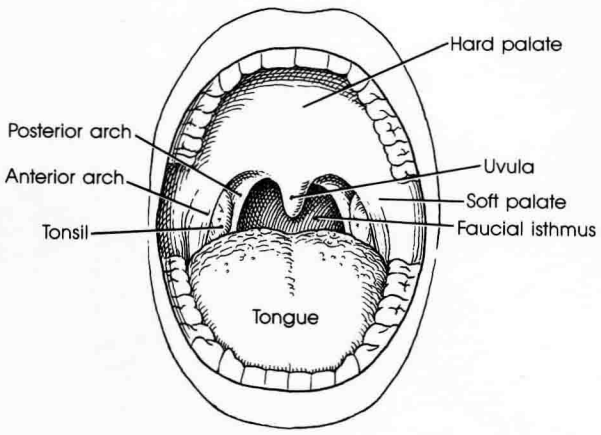

Fig. 14-1. Anterior aspect of oral cavity.

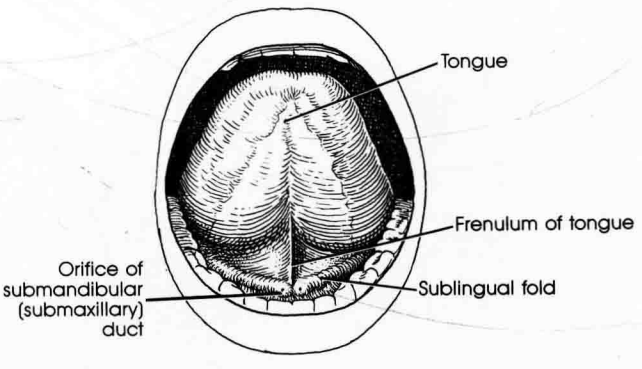

Fig. 14-2. Anterior view of undersurface of tongue and floor of mouth.

Salivary Glands

The three pairs of salivary glands are the *parotid,* the *submandibular (submaxillary),* and the *sublingual* (Fig. 14-3). The glands are composed of numerous lobes, each of which is made up of small lobules, the whole being held together by connective tissue and a fine network of blood vessels and ducts. The ductules of the lobules coalesce into larger branches, which in turn unite and form the large efferent duct, which conveys the saliva from the gland to the mouth.

The *parotid gland* is the largest of the salivary glands and consists of a flattened superficial portion and a wedge-shaped deep portion (Fig. 14-4). The superficial part lies immediately inferior and anterior to the external ear, overlapping the mandibular ramus and the mastoid process, and extends from the level of the external acoustic (auditory) meatus inferiorly almost to the angle of the mandible. The deep, or retromandibular, portion extends medially toward the pharynx. The parotid duct *(Stensen's duct)* runs anteriorly and medially to open into the oral vestibule opposite the second upper molar.

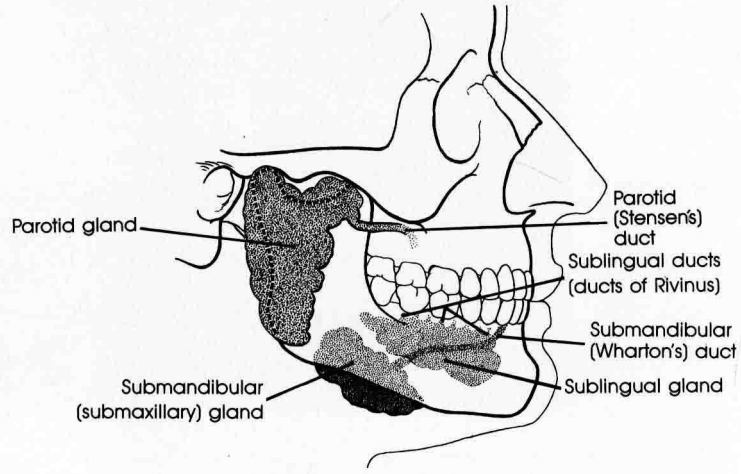

Fig. 14-3. Salivary glands from right lateral aspect.

The *submandibular (submaxillary) gland* is irregularly shaped, is fairly large, and extends posteriorly from a point below the first molar almost to the angle of the mandible (Fig. 14-5). Although the upper part of the gland rests against the inner surface of the mandibular body, its greater portion projects below the mandible. The submandibular duct (submaxillary or *Wharton's duct*) extends anteriorly and superiorly to open into the mouth on a small papilla at the side of the frenulum of the tongue, the sublingual caruncle.

The *sublingual gland,* composed of a group of smaller glands, is narrow and elongated in form (Fig. 14-5). This gland is located in the floor of the mouth beneath the sublingual fold (plica sublingualis). It is in contact with the mandible laterally, and it extends posteriorly from the side of the frenulum linguae to the submandibular *(submaxillary)* gland. There are numerous small sublingual ducts *(ducts of Rivinus),* some of which open into the floor of the mouth along the crest of the sublingual fold and others of which open into the submandibular (submaxillary) duct. The main sublingual duct *(Bartholin's duct)* opens beside the orifice of the submandibular duct (submaxillary or Wharton's duct).

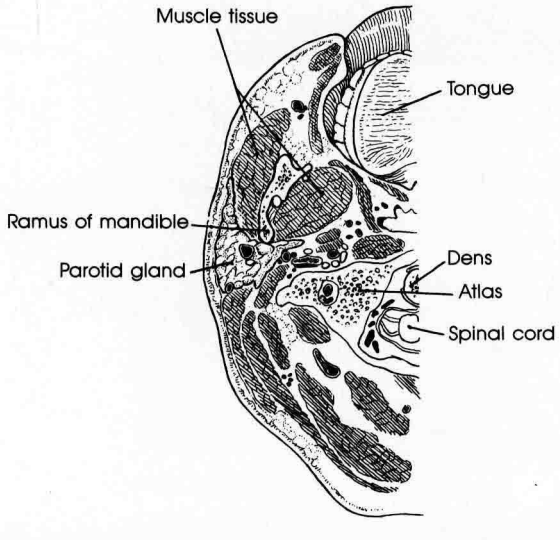

Fig. 14-4. Transverse section of face showing relation of parotid gland to mandibular ramus.

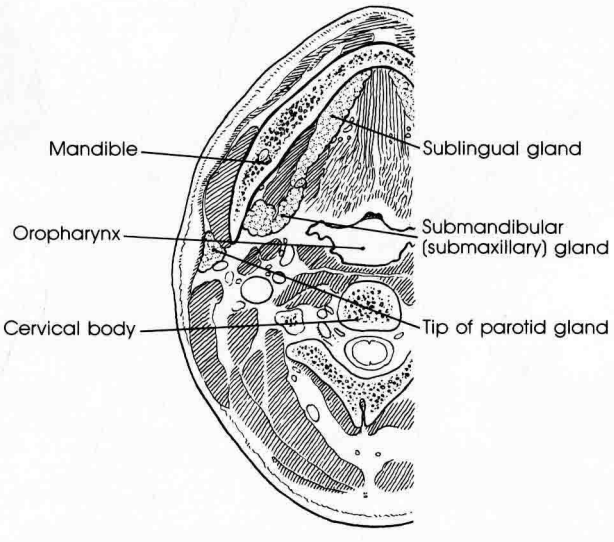

Fig. 14-5. Transverse section of face showing relation of submandibular (submaxillary) and sublingual glands to surrounding structures.

Sialography

Sialography is the term applied to radiologic examinations of the salivary glands and ducts with the use of a contrast medium, usually one of the water-soluble iodinated media. The frequency of performing sialograms has decreased during the past few years because of improvements in computed tomography (CT) and magnetic resonance imaging (MRI) techniques. When the clinician is evaluating a patient with a suspected salivary stone or lesion, CT or MRI is often the modality of choice. However, when a definitive diagnosis is needed involving one of the salivary ducts, sialography remains a viable diagnostic tool.

In performing a sialogram, the radiopaque medium is injected into the main duct, from where it flows into the intraglandular ductules. This makes it possible to demonstrate the surrounding glandular parenchyma as well as the duct system (Fig. 14-6). The procedure is used to demonstrate such conditions as inflammatory lesions and tumors, to determine the extent of salivary fistulae, and to localize diverticulae, strictures, and calculi. Because the glands are paired, and the several pairs are in such close proximity, only one gland at a time can be examined by the sialographic method (Fig. 14-7).

Fig. 14-6. Sialogram showing opacified submaxillary gland.

Preliminary radiographs are obtained to detect any condition demonstrable without the use of a contrast medium and to establish the optimum exposure technique.

Two or three minutes before the sialographic procedure, the patient is given a secretory stimulant to open the duct for ready identification of its orifice and for easier passage of a cannula or catheter. Having the patient suck a wedge of fresh lemon serves this purpose and is repeated on completion of the examination to stimulate rapid evacuation of the contrast medium. A radiograph may be taken some 10 minutes later to verify clearance of the medium.

Most examiners inject the contrast medium by manual pressure, that is, with a syringe attached to the cannula or catheter. Other examiners advocate that the medium be delivered by hydrostatic pressure only. The latter method requires the use of a water-soluble iodinated medium, with the contrast solution container (usually a syringe barrel with the plunger removed) attached to a drip stand and set at a distance of 28 inches (70 cm) above the level of the patient's mouth. Some examiners carry out the filling procedure under fluoroscopic guidance and obtain spot radiographs. The reader is referred to the articles listed in the bibliography for a detailed description of each of the numerous methods of performing sialography.

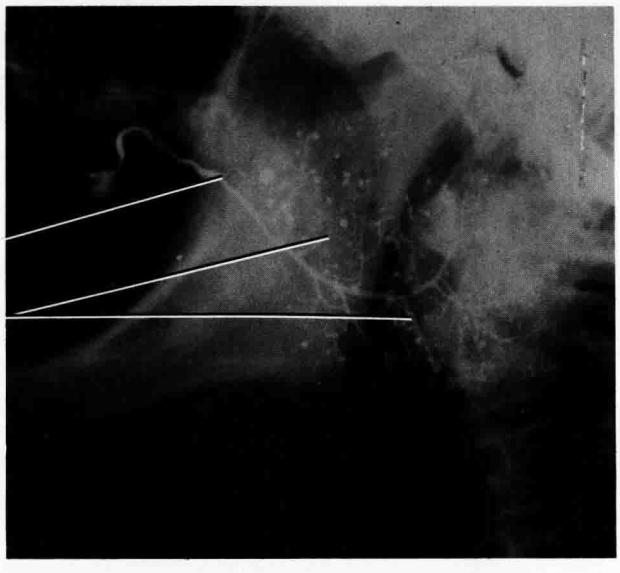

Fig. 14-7. Sialogram showing parotid gland.

Parotid Gland

TANGENTIAL POSITION

Film: 8 × 10 in (18 × 24 cm) lengthwise.

Position of patient

The patient may be placed in either a recumbent or a seated position. Since the parotid gland lies midway between the anterior and posterior surfaces of the skull, a tangential position of the gland region can be taken from either the posterior or the anterior direction.

Position of part

AP body position. With the patient supine, rotate the head toward the side being examined so that the parotid area is perpendicular to the plane of the film. Center the film to the parotid area. With the patient's head resting on the occiput, adjust it so that the mandibular ramus is parallel with the longitudinal axis of the film (Fig. 14-8).

PA body position. With the patient prone, rotate the head so that the parotid area being examined is perpendicular to the plane of the film. Center the film to the parotid region. With the patient's head resting on the chin, adjust its flexion so that the mandibular ramus is parallel with the longitudinal axis of the film (Fig. 14-9). When the parotid (Stensen's) duct does not have to be demonstrated, rest the head on the forehead and nose.

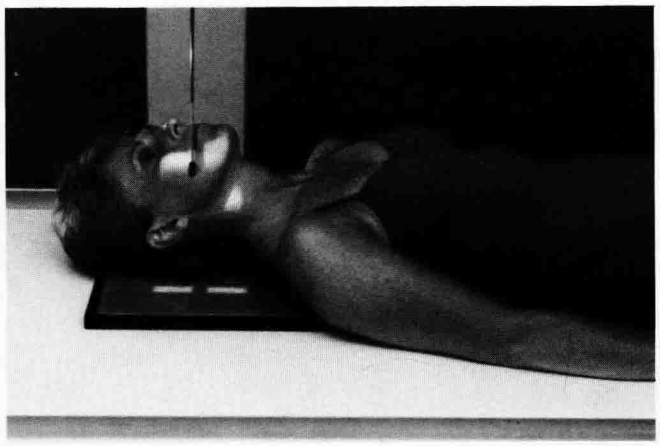

Fig. 14-8. Patient supine.

Fig. 14-9. Patient prone.

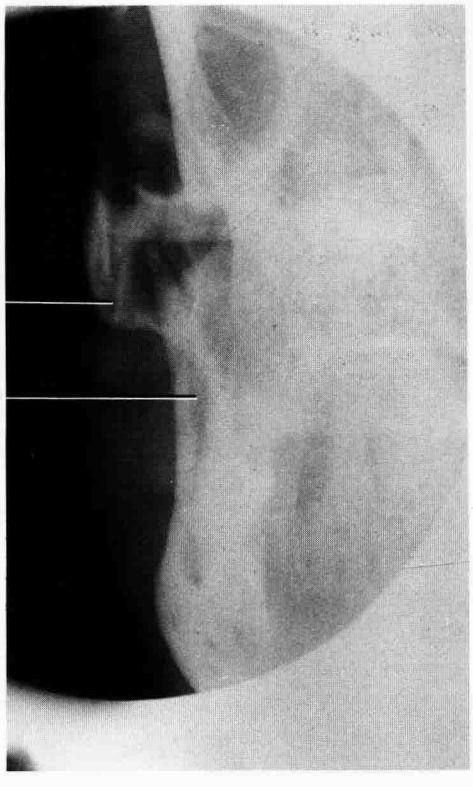

Fig. 14-10. Examination of right cheek area to rule out parotid gland tumor. Soft tissue fullness. No calcification.

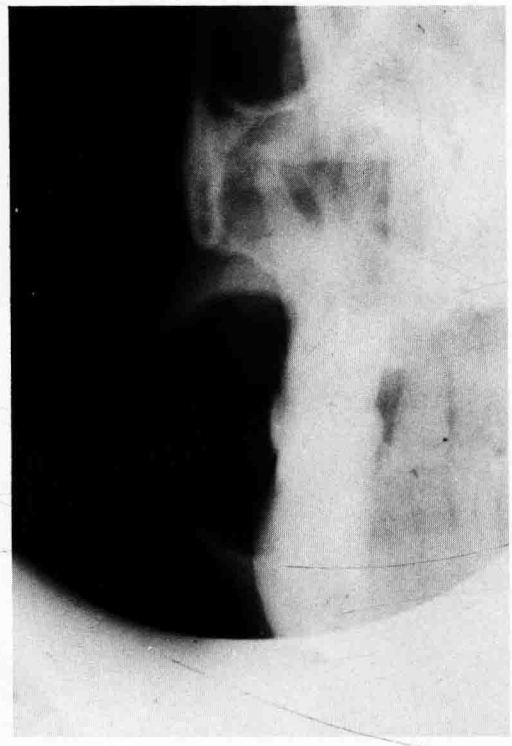

Fig. 14-11. Same patient as in Fig. 14-10. Right cheek distended with air in mouth. No abnormal finding in region of parotid gland.

(Courtesy Dr. William H. Shehodi.)

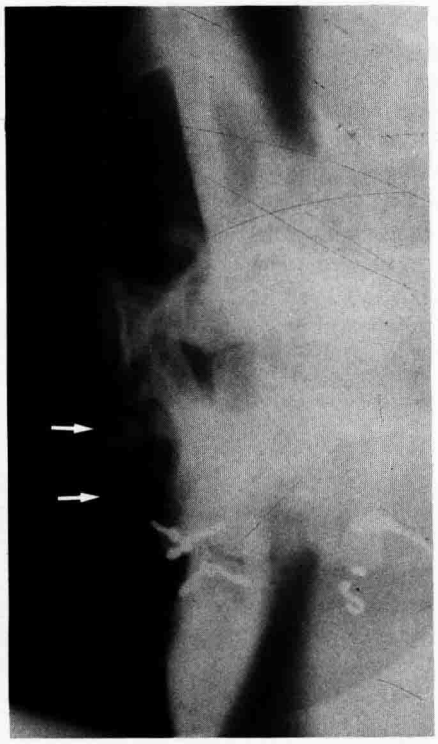

Fig. 14-12. Right cheek distended with air. Considerable calcification seen in region of parotid gland *(arrows)*.

(Courtesy Dr. William H. Shehodi.)

Respiration. To study the parotid gland, better detail can be obtained, particularly for the demonstration of calculi, by having the patient fill the mouth with air and then puff the cheeks out as much as possible. When this cannot be done, ask the patient to suspend respiration for the exposure.

Central ray

With the central ray perpendicular to the plane of the film, direct it along the lateral surface of the mandibular ramus.

Structures shown

A tangential position demonstrates the region of the parotid gland and duct. These structures are clearly outlined when an opaque medium is used (Figs. 14-10 to 14-14).

Evaluation criteria

- Soft tissue density should be visible.
- Most of the parotid gland should be demonstrated lateral to and clear of the mandibular ramus.
- Mastoid should only overlap the upper portion of the parotid gland.

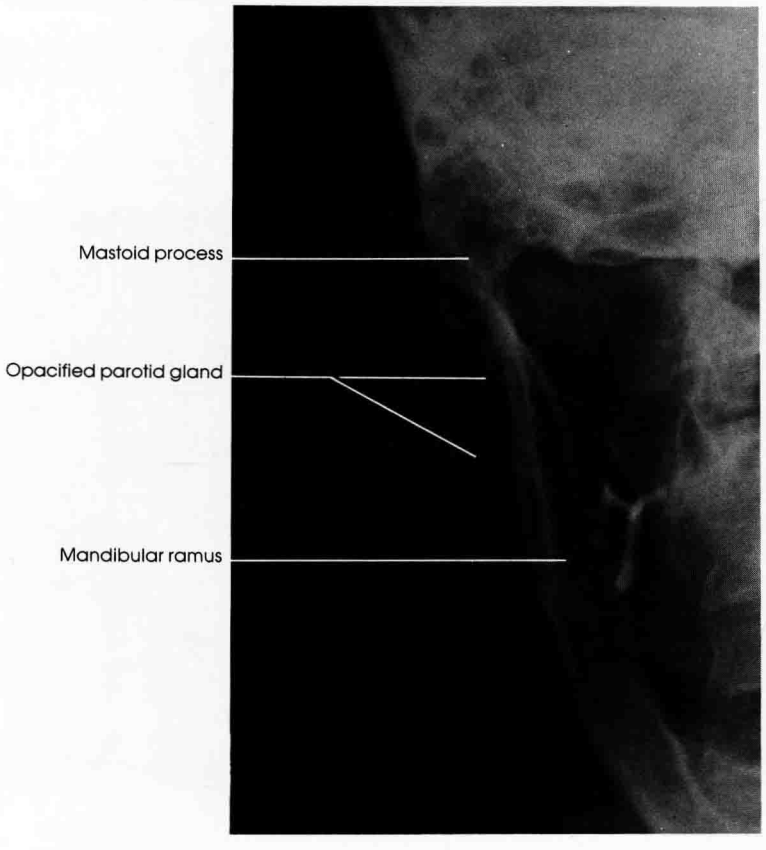

Fig. 14-13. Tangential position showing opacified parotid gland.

Fig. 14-14. Tangential position showing opacified parotid gland.

(Courtesy Dr. Milford D. Schultz.)

Parotid and Submaxillary Glands

LATERAL POSITION

Film: 8 × 10 in (18 × 24 cm) lengthwise.

Position of patient

The patient may be examined in a semiprone or seated-upright position.

Position of part

Parotid gland. Extend the patient's neck so the space between the cervical area of the spine and the mandibular rami is cleared. Center the film to a point approximately 1 inch (2.5 cm) superior to the mandibular angle. Adjust the head so that the midsagittal plane is rotated forward approximately 15 degrees from a true lateral position.

Submandibular gland. Center the film to the inferior margin of the angle of the mandible. Adjust the patient's head in a true lateral position (Fig. 14-15).

Iglauer[1] suggested depressing the floor of the mouth to displace the submandibular gland below the mandible. When the patient's throat is not too sensitive, this is done by placing an index finger on the back of the patient's tongue on the affected side.

Respiration is suspended for the exposure.

[1]Iglauer S: A simple maneuver to increase the visibility of a salivary calculus in the roentgenogram, Radiology 21:297, 1933.

Central ray

Direct the central ray perpendicularly to the center of the cassette at a point (1) 1 inch (2.5 cm) superior to the mandibular angle to demonstrate the parotid gland or (2) at the inferior margin of the mandibular angle to demonstrate the submandibular gland.

Fig. 14-15. Lateral submandibular gland.