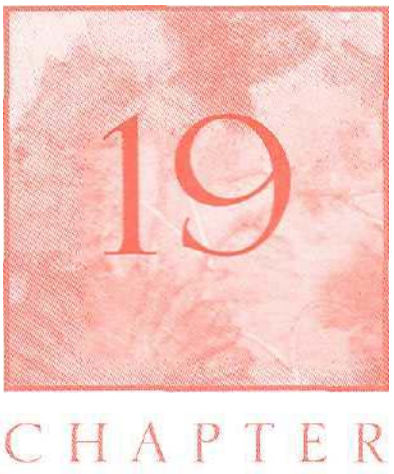
Odontogenic Diseases of the Maxillary Sinus

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CHAPTER OUTLINE

EMBRYOLOGY AND ANATOMY
CLINICAL EXAMINATION OF MAXILLARY SINUS
RADIOGRAPHIC EXAMINATION OF MAXILLARY SINUS
ODONTOGENIC INFECTIONS OF MAXILLARY SINUS
TREATMENT OF MAXILLARY SINUSITIS
COMPLICATIONS OF SURGERY INVOLVING MAXILLARY SINUS
MUCOUS-RETENTION PHENOMENON
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EMBRYOLOGY AND ANATOMY

The maxillary sinuses are air-containing spaces that occu-py the maxillary bone bilaterally. They are the first of the paranasal sinuses (e.g., maxillary, ethmoid, frontal, sphe-noid) to develop embryonically and begin as a mucosal invagination that grows laterally from the middle meatus of the nasal cavity at approximately the seventieth day of gestation. At birth the sinus cavity is still somewhat less than a centimeter in any dimension.

After birth the maxillary sinus expands by pneumatization into the developing alveolar process and extends anteriorly and inferiorly from the base of the skull, closely matching the growth rate of the maxilla and the development of the dentition. As the dentition develops, portions of the alveolar process of the maxilla, vacated by the eruption of teeth, become pneumatized. By the time a child reaches age 12 or 13, the sinus will have expanded to the point at which its floor will be on the same horizontal level as the floor of the nasal cavity. Expansion of the sinus normally ceases after the eruption of the permanent teeth but will, on occasion, pneumatize further, after the removal of one or more posterior maxillary teeth, to occupy the residual alveolar process. The sinus may then extend virtually to the crest of the edentulous ridge. In adults the apices of the teeth may extend into the sinus cavity and may be identified readily in the dry skull lying in the sinus floor.

The sinuses are lined by respiratory epithelium—a mucous-secreting, pseudostratified, ciliated, columnar epithelium—and periosteum. The cilia and mucus are necessary for the drainage of the sinus, because the sinus opening, or ostium, is not in a dependent position but lies two thirds the distance up from the inferior part of the medial wall and drains into the nasal cavity. The maxillary sinus opens into the posterior, or inferior, end of the semilunar hiatus, which lies in the middle meatus of the nasal cavity, between the inferior and middle nasal conchae. The ostium remains at the level of the original lateral extension from the nasal cavity from which the sinus began formation in the embryo and the location of which is close to the roof of the sinus (Fig. 19-1). Beating of the cilia moves the mucus produced by the lining epithelium and any foreign material contained within the sinus toward the ostium, from which it drains into the nasal cavity.

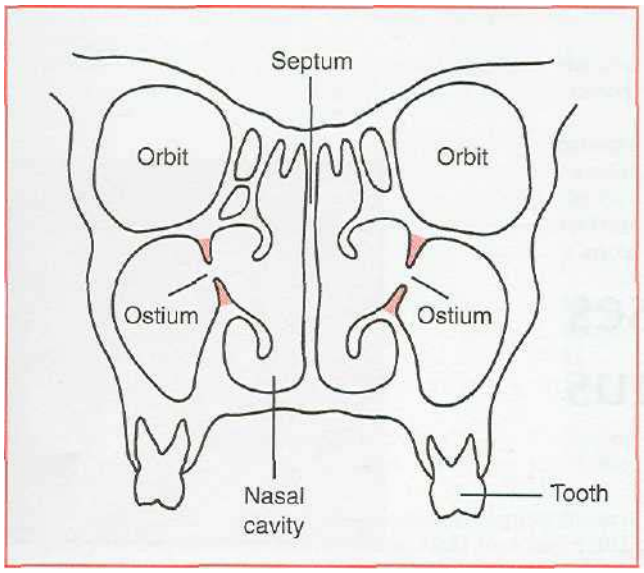


FIG.19-1 Frontal diagram of midface at ostium or opening of maxillary sinuses into middle meatus of nasal cavity. Ostium is in upper third of sinus cavity.

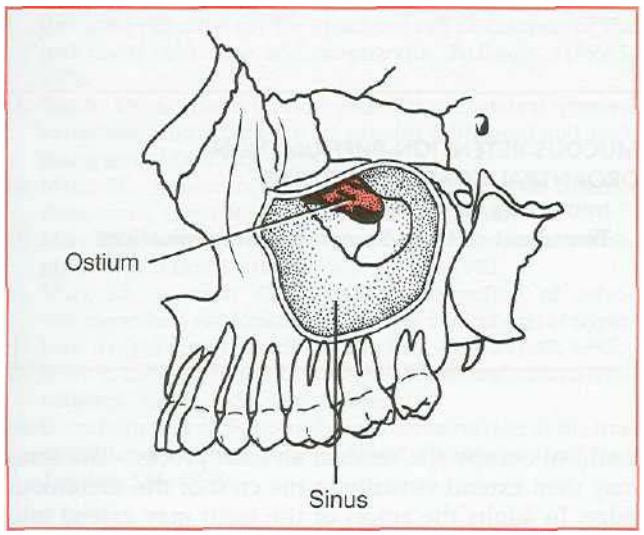


FIG. 19-2 Lateral diagram of right maxillary sinus with zygoma removed. Medial sinus wall (i.e., lateral nasal wall) is seen in depth of sinus, as is ostium. Maxillary sinus is pyramidal, with its apex directed into base of zygoma.

The maxillary sinus is the largest of the paranasal sinuses. It may be described as a four-sided pyramid, with the base lying vertically on the medial surface and forming the lateral nasal wall. The apex extends laterally into the zygomatic process of the maxilla. The upper wall, or roof, of the sinus is also the floor of the orbit. The posterior wall extends the length of the maxilla and dips into the maxillary tuberosity. Anteriorly and laterally the sinus extends to the region of the first bicuspid or cuspid teeth. The floor of the sinus forms the base of the alveolar process. The adult maxillary sinus averages 34 mm in anteroposterior direction, 33 mm in height, and 23 mm in width. Its volume is approximately 15 cc (Fig. 19-2).

CLINICAL EXAMINATION OF MAXILLARY SINUS

Clinical examination of the patient with suspected maxillary sinus disease should include tapping of the lateral walls of the sinus externally over the prominence of the cheekbones and palpation intraorally on the lateral surface of the maxilla between the canine fossa and the zygomatic buttress. The affected sinus may be markedly tender to gentle tapping or palpation. Further examination may include transillumination of the maxillary sinuses. In unilateral disease, one sinus may be compared with the sinus on the opposite side. The involved sinus shows decreased transmission of light secondary to the accumulation of fluid, debris, and pus and the thickening of the sinus mucosa.

Transillumination of the maxillary sinus is done by placing a bright flashlight or fiber optic light against the mucosa on the palatal or facial surfaces of the sinus and observing the transmission of light through the sinus in a darkened room. These simple tests help to distinguish sinus disease, which may cause pain in the upper teeth, from abscess or other pain of dental origin associated with the molar and bicuspid teeth.

RADIOGRAPHIC EXAMINATION OF MAXILLARY SINUS

Radiographic examination of the maxillary sinus may be accomplished with a wide variety of exposures readily available in the dental office or radiology clinic. These exposures include periapical, occlusal, and panoramic views, which will, in most instances, provide adequate information to either confirm or rule out pathologic conditions of the sinus. If additional radiographic information is required, Waters' radiographs (Fig. 19-3) are usually diagnostic. Rarely, linear tomography (Fig. 19-4) and computed axial tomography (Fig. 19-5) of the structures in question may be necessary.

Interpretation of radiographs of the maxillary sinus is not difficult. The findings in the normal antrum are those to be expected of a rather large, air-filled cavity surrounded by bone and dental structures. The body of the sinus should appear radiolucent and should be outlined in all peripheral areas by a well-demarcated layer of cortical bone. It is helpful to compare one side to the other when examining the radiographs. There should be no evidence of thickened mucosa on the bony walls (usually indicative of chronic sinus disease) (see Fig. 19-3), air-fluid levels (caused by accumulation of mucus, pus, or blood) (FIG. 19-6), or foreign bodies lying free. Frequently, the apices of the roots of the posterior maxillary teeth and impacted third molars may be seen to project into the sinus floor (Fig. 19-7). In edentulous areas the sinus may be pneuma-tized into the alveolar process and extend almost to the alveolar crest. Complete opacification of the maxilla sinus may be caused by the mucosal hypertrophy and fluid accumulation of sinusitis, by filling with blood sec ondary to trauma, or by neoplasia (Fig. 19-8).

Disruption of the cortical outline may be a result of trauma, tumor formation, or surgical procedures that violate the sinus walls.

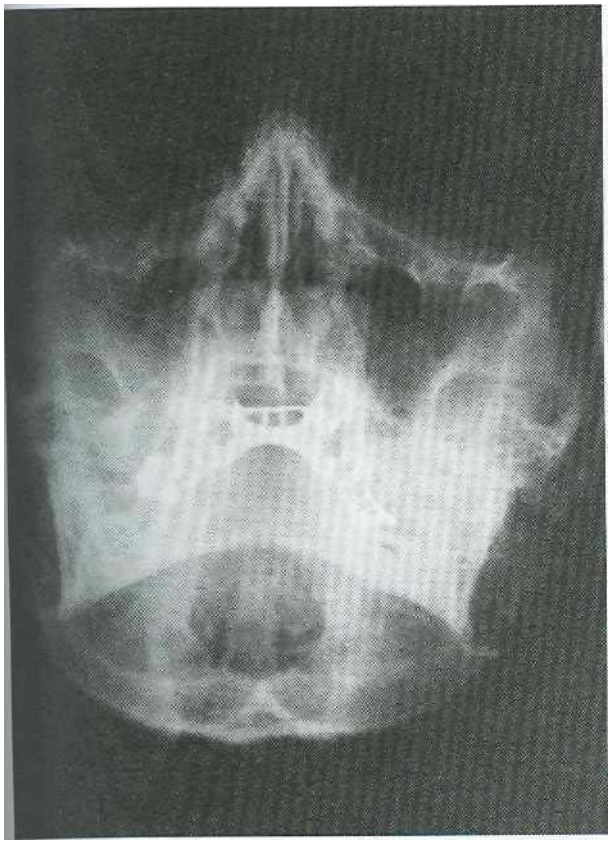


FIG. 19-3 Waters' radiograph showing mucosal thickening on right maxillary sinus floor and lateral wall. Patient had oroantral fistula secondary to removal of first molar tooth and symptoms of chronic maxillary sinusitis.

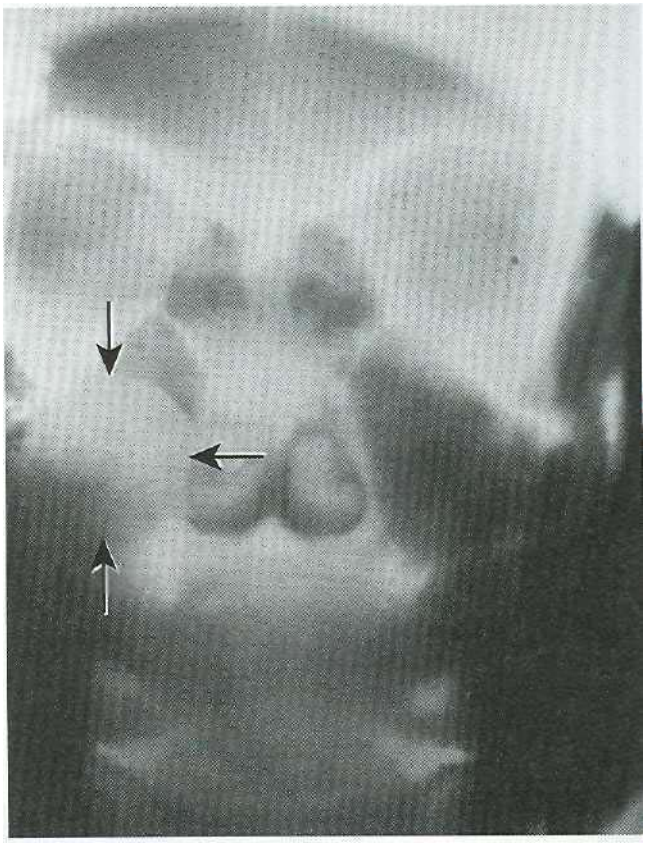


FIG. 19-4 Tomogram of midface taken in frontal plane. Large, cystlike radiolucent lesion is seen to occupy bulk of right maxillary sinus *(arrows)*.

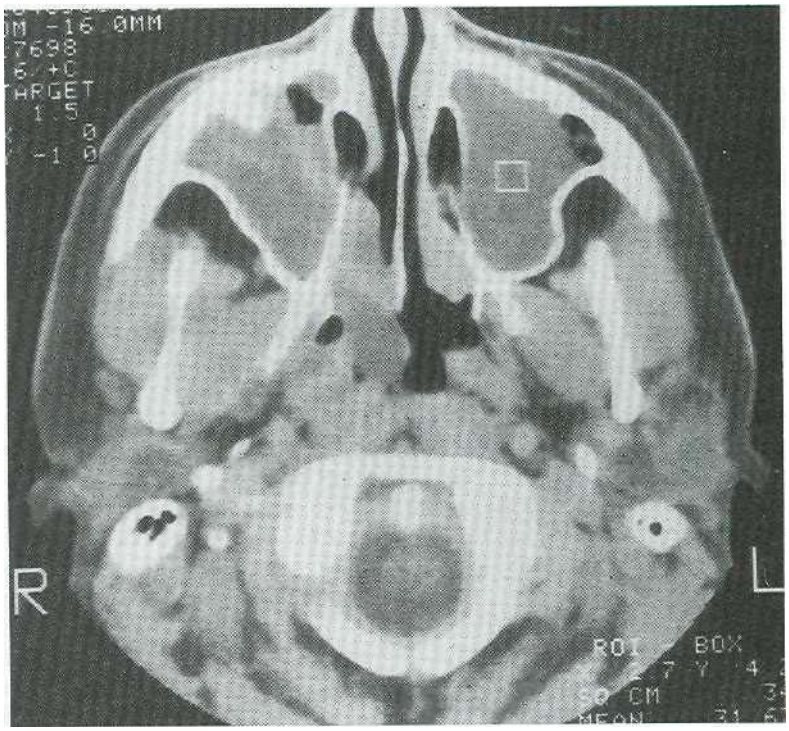


FIG. 19-5 Computed axial tomogram of head in coronal plane. Both maxillary sinuses are almost totally opacified by mucosal lesions, as is right nasopharynx. Such lesions are typical of allergic disease or chronic sinusitis.

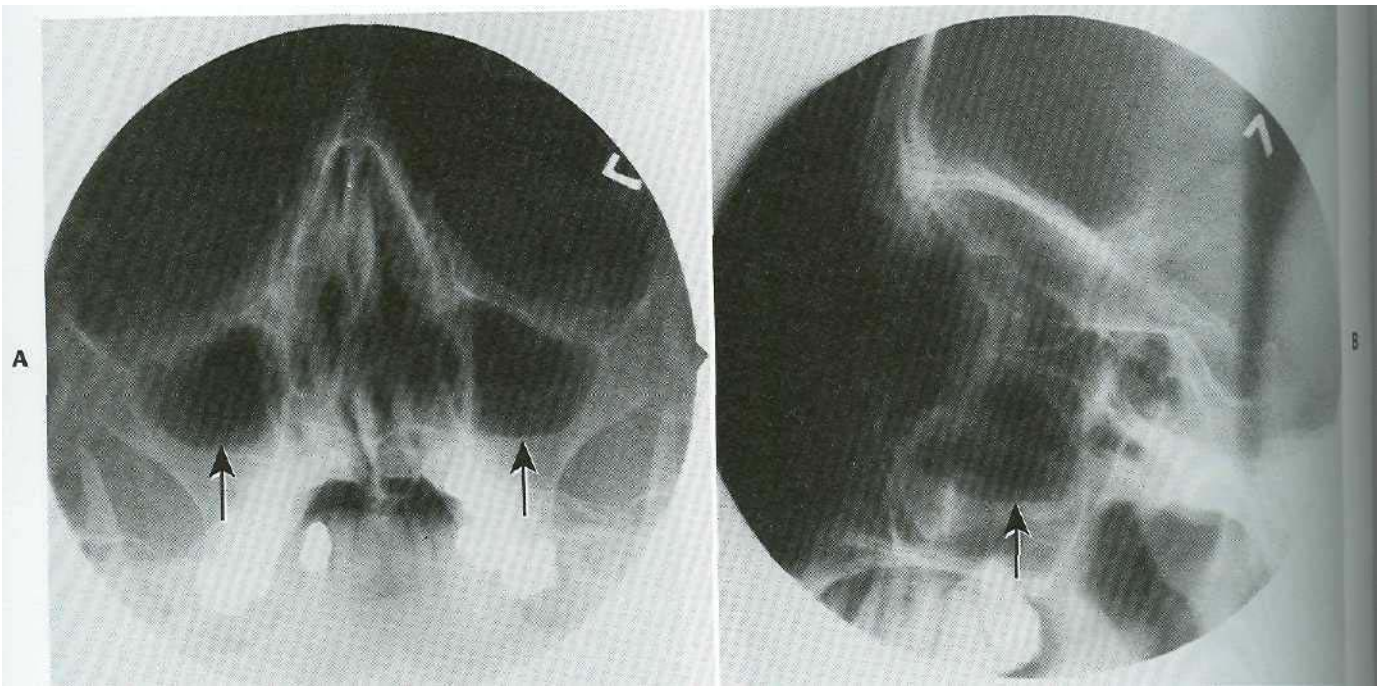


FIG. 19-6 A, Waters' radiograph demonstrates bilateral maxillary sinus air-fluid levels (arrows). B, Lateral radiograph demonstrates air-fluid levels in maxillary sinus *(arrow).*

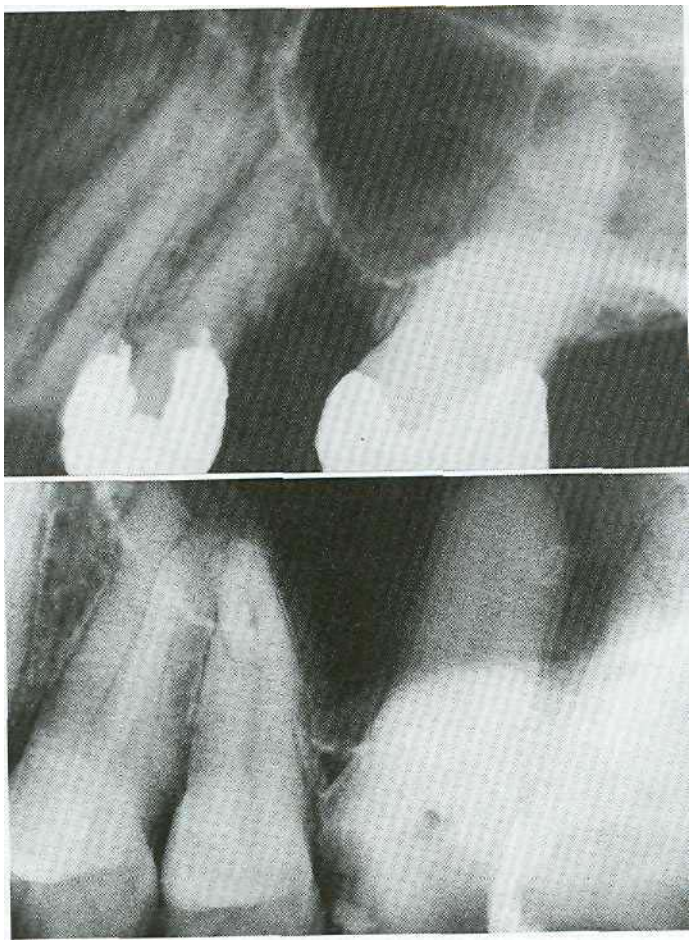


FIG. 19-7 Maxillary molar roots appear to be "in" sinus, because sinus has pneumatized around roots.

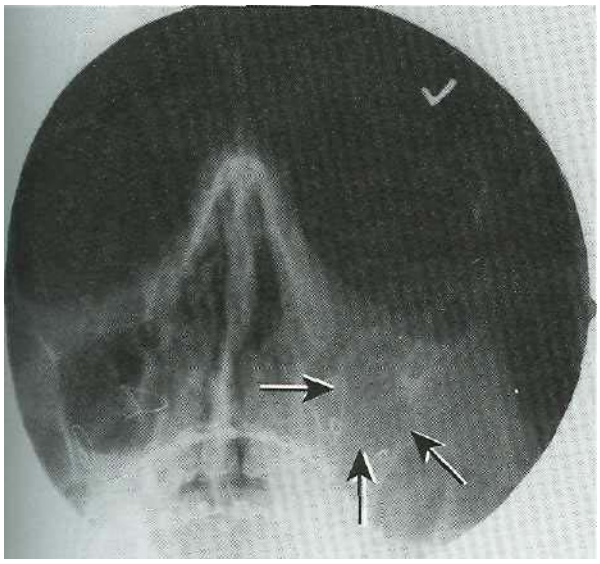


FIG. 19-8 Waters' radiograph shows opacification of left maxillary sinus by hypertrophied tissue and purulent material *(arrows)*. Patient was previously treated with Le Fort I osteotomy.

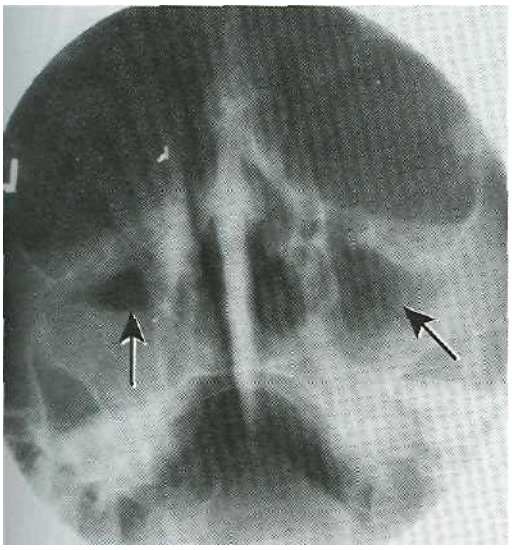


FIG. 19-9 Waters' radiograph showing air-fluid level in left maxillary sinus and mucosal thickening in right maxillary sinus *(arrows)*.

Radiographic changes are to be expected with acute maxillary sinusitis and are secondary to filling of a normal, air-containing cavity with thickened mucosal sinus lining and accumulated mucus, pus, or both. Mucosal thickening secondary to odontogenic infections may obstruct the ostium of the sinus and allow accumulation of mucus, which will become infected and produce pus. The characteristic radiographic changes may include an air-fluid level in the sinus (see Fig. 19-6), thickened mucosa on any or all of the sinus walls (see Fig. 19-3), or complete opacification of the sinus cavity (see Fig. 19-8).

The radiographic changes indicative of chronic maxillary sinusitis include mucosal thickening, sinus opacification, and nasal or antral polyps. Air-fluid levels in the sinuses are more characteristic of acute sinus disease but may be seen in chronic sinusitis in periods of acute exacerbation (Fig. 19-9).

Dental pathologic conditions such as cysts or granulomas may produce radiolucent lesions that extend into the sinus cavity. They may be distinguished from normal sinus anatomy by their association with the tooth apex, the clinical correlation with the dental examination, and the presence of a cortical osseous margin on the radiograph, which generally separates the area in question from the sinus itself (Fig. 19-10).

Periapical, occlusal, and, occasionally, panoramic radiographs are of value in locating and retrieving foreign bodies within the sinus—particularly teeth, root tips, or osseous fragments—that have been displaced by trauma or during tooth removal (Fig. 19-11). These radiographs should also be used for the careful planning of surgical removal of teeth adjacent to the sinus.

ODONTOGENIC INFECTIONS OF MAXILLARY SINUS

The mucosa of the sinus is susceptible to infectious, allergic, and neoplastic diseases. Inflammatory diseases of the sinus, such as infection or allergic reactions, cause hyperplasia and hypertrophy of the mucosa and produce the signs and symptoms of sinusitis, as well as the radiographic changes seen with these conditions. If the ostium of the sinus becomes obstructed, the mucus produced by the secretory cells lining the walls is collected over long periods. Bacterial overgrowth may then produce an infection.

When inflammation develops in any of the paranasal sinuses, whether caused by infection or allergy, the condition is described as *sinusitis*. Inflammation of most or all of the paranasal sinuses simultaneously is known as *pansinusitis* and is usually caused by infection. Similar conditions of individual sinuses are known, for example, as *maxillary sinusitis* or *frontal sinusitis*. Maxillary sinusitis is commonly odontogenic in nature because of the anatomic juxtaposition of the teeth and the maxillary sinus. This condition may readily spread to involve the other paranasal sinuses if it is left untreated or inadequately treated or is fulminant or chronic in nature. Like infections, maxillary sinusitis may be acute or chronic.

Odontogenic infections that may involve the maxillary sinus include acute and chronic periapical disease and periodontal disease. Infection and sinusitis may also result from trauma to the dentition or from surgery in the posterior maxilla, including removal of teeth, alveolectomy, tuberosity reduction, or other procedures that cause communications between the oral cavity and the maxillary sinus.

Acute maxillary sinusitis may occur at any age. Its onset is usually described by the patient as a rapidly developing sense of pressure, pain, or fullness in the vicinity of the affected sinus. The discomfort rapidly increases in intensity and may be accompanied by facial swelling and erythema, malaise, fever, and drainage of foul-smelling mucopurulent material into the nasal cavity and nasopharynx.

Chronic maxillary sinusitis is a less common result of odontogenic infection. It is usually a result of bacterial or fungal infections that are low-grade and recur-

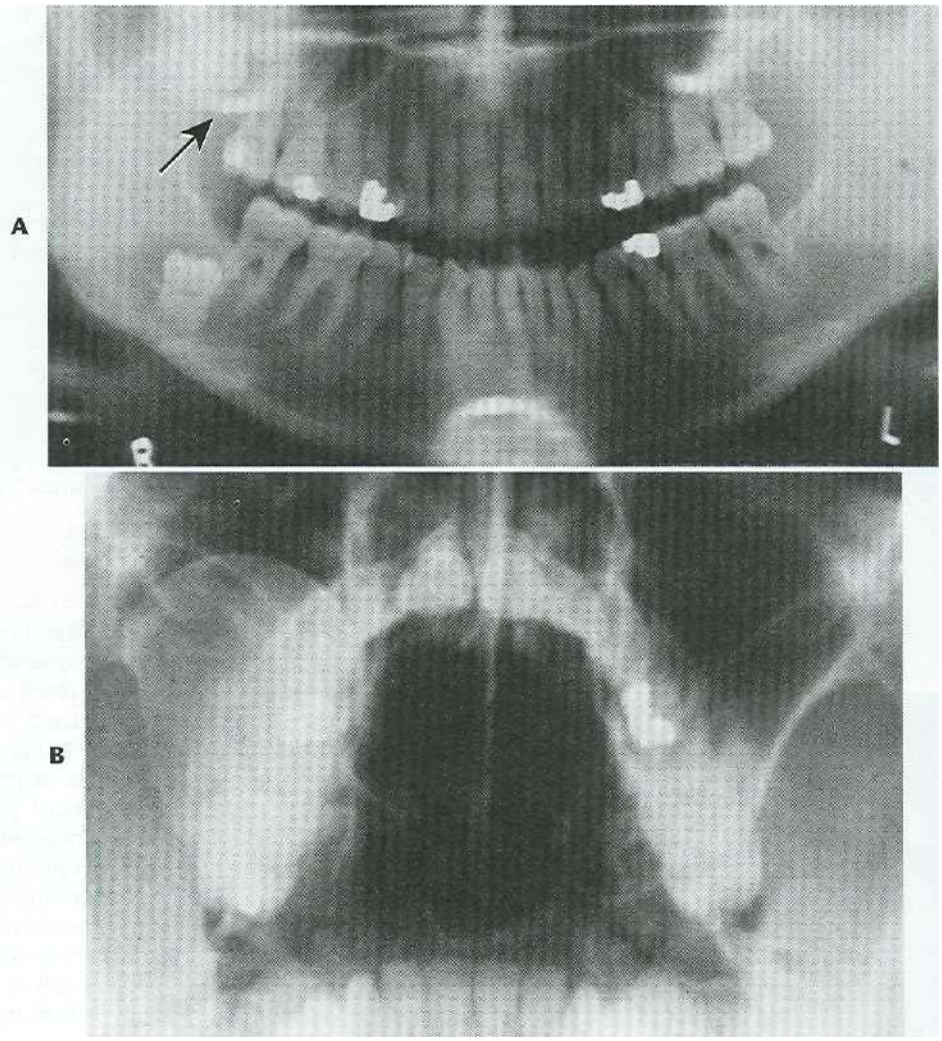


FIG. 19-10 A, Panoramic radiograph shows large odontogenic keratocyst associated with impacted right maxillary third molar tooth *(arrow)*. Cyst has impinged on right maxillary sinus as it expanded. Sinus cavity is almost totally obstructed by lesion. Another odontogenic keratocyst is seen associated with impacted right mandibular third molar. B, Waters' radiograph demonstrates the odontogenic keratocyst (seen in A). Lesion is also seen to have expanded lateral wall of right maxillary sinus.

rent in nature, obstructive nasal disease, or allergy. It is characterized by episodes of sinus disease that respond initially to treatment, only to return, or that remain symptomatic in spite of treatment.

Aerobic, anaerobic, or mixed bacteria may cause infections of the maxillary sinuses. The normal healthy maxillary sinus has a small population of bacteria that is composed mainly of aerobic streptococci and anaerobic gram-negative rods of the genera *Porphyromonas, Prevotella,* and *Fusobacterium.* In maxillary sinusitis of nonodontogenic origin, the causative bacteria are primarily aerobic, with a few anaerobes. The important aerobes are *Streptococcus pneumoniae, Haemophilus influenzae,* and *Staphylococcus aureus. Porphyromonas, Prevotella, Peptococcus,* and *Fusobacterium* spp. are the common anaerobes.

Maxillary sinus infections of odontogenic origin are more likely to be caused by anaerobic bacteria as is the usual odontogenic infection. Rarely does *H. influenzae* or *S. aureus* cause odontogenic sinusitis. The predominant organisms are aerobic streptococci and anaerobic *Peptococcus, Peptostreptococcus, Porphyromonas, Prevotella,* and *Eubacterium* spp.

This information is important to the selection of an antibiotic. The otolaryngologist usually chooses a drug that is effective against *H. influenzae* and *S. aureus,* which is not usually necessary for odontogenic sinusitis. Drugs such as penicillin, erythromycin, and clindamycin are effective for sinusitis of odontogenic origin.

However, because of the wide variety of microorganisms that can be participants in infections of the maxillary sinus, it is important to obtain purulent material for culture and sensitivity (C&S) testing whenever possible. Sensitivity testing may suggest a change to another antibiotic if resistant organisms are cultured from the sinus and if the infection is failing to respond to appropriate initial treatment. As many as 25% of the organisms

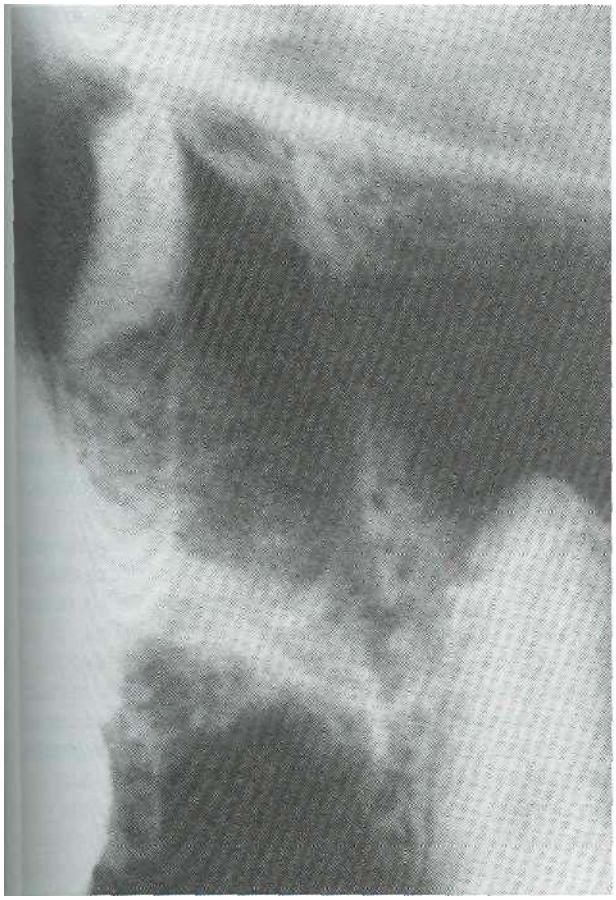


FIG.19-11 Periapical radiograph showing apical one third of palatal root of maxillary first molar, which was displaced into maxillary sinus during removal of tooth.

cultured from acute sinus infections are beta-lactamase producers and many may be anaerobic, especially if the infection is odontogenic in origin.

TREATMENT OF MAXILLARY SINUSITIS

Early treatment of maxillary sinusitis consists of humidification of inspired air to loosen and aid in the removal of dried secretions from the nasal passage and the sinus ostium. Also required are antibiotics, systemic deconges-tants, and topically applied decongestants to decrease mucosal edema and inflammation and to promote drainage of the sinus through its natural opening. On occasion, surgical drainage of the sinus is indicated. The cause of the sinusitis should be diagnosed, treated, and eliminated.

Treatment is directed at relief of pain, and narcotic analgesics are usually required. A nasal spray containing vasoconstrictors, such as 2% ephedrine or 0.25% phenyleprine, is prescribed, as are orally administered antihistamines, such as pseudoephedrine (Sudafed). Antibiotics, selected empirically as described previously, are prescribed for a period of 10 to 14 days. Purulent material is submitted for C&S testing, using both aerobic and anaerobic techniques.

If the patient fails to respond to this initial treatment regimen within 72 hours, it is necessary to reassess the treatment and the antibiotic. If the cause of the problem has not been identified and eliminated, this should be accomplished. The results of the C&S tests should be evaluated, and changes should be made if indicated. If the organism or organisms causing the infection is a beta-lactamase producer, another antibiotic, such as the combination agent trimethoprim-sulfamethoxazole (Bactrim, Septa), may be effective. Cefaclor or a combination of amoxicillin and potassium clavulanate (Augmentin) have also been shown to be effective.

Acute maxillary sinusitis is a painful, potentially serious condition that requires immediate attention and aggressive medical and surgical care. Patients suspected of having maxillary sinusitis should be referred to an oral and maxillofacial surgeon or another specialist, such as an otolaryngologist. Radiographs, the results of clinical procedures, the results of C&S tests of purulent drainage, and any other pertinent diagnostic information should be sent to the surgeon by the referring clinician.

Diagnosis and treatment of chronic maxillary sinusitis is difficult and may include allergy testing, nasal or septal surgery, surgical debridement of the sinuses with a Caldwell-Luc procedure, or sinus trephination and irrigation.

Untreated maxillary sinusitis may progress to a variety of serious complications if inadequately treated. These potential problems include orbital cellulitis, cavernous sinus thrombosis, meningitis, osteomyelitis, intracranial abscess, and death.

COMPLICATIONS OF SURGERY INVOLVING MAXILLARY SINUS

Sinus lift procedures, done primarily as preprosthetic surgical procedures to improve the posterior maxillary alveolar base for secondary or simultaneous endosseous implant placement occasionally contribute to sinus infections. In most cases careful elevation of the Schneiderian (i.e., sinus) membrane creates a secluded space into which particulate grafts of autologous bone, allogeneic bone, alloplastic materials, or combinations of these can be placed. If the procedure is done carefully, complications resulting from sinus lift operations are rare. They became more frequent in at least two instances: (1) when the sinus membrane is severely lacerated or avulsed or (2) when the sinus is overfilled.

Significant disruption of the sinus membrane allows exposure of the graft material to the open sinus and possible contamination by nasal bacteria. It also allows particulate material from the sinus grafts or implants to become free foreign bodies within the sinus, which can cause foreign-body rejection responses from the sinus mucosa or outright infection. Lacerated sinus membranes may also interfere with normal nasal epithelial ciliary motility and thereby impede physiologic sinus drainage. Finally, fragments of sinus mucosa or graft material may obstruct the sinus ostium, further preventing normal sinus drainage.

When these situations occur, treatment consists of infection control and removal of contaminated or devitalized graft materials. This treatment also includes

removal of foreign-body free segments and debulking of overly extended grafts. These procedures are usually accomplished through a Caldwell-Luc lateral sinus wall surgical approach or, rarely, with nasal access endoscopic sinus surgery. Patients having sinus disease suspected to be caused by or secondary to sinus lift procedures should be referred to an oral and maxillofacial surgeon for evaluation and treatment. Antibiotic therapy alone may temporarily improve the acute problem, but the ultimate treatment will require sinus exploration and debridement by a surgeon.

Midface orthognathic surgical procedures, to include maxillary osteotomies are common operations performed by oral and maxillofacial surgeons to correct facial deformities and maxillomandibular jaw size discrepancies. Most of these procedures include osteotomies to mobilize the maxilla so that it can be moved and stabilized in a more advantageous position. The bone cuts needed to perform this operation are made through the lateral and medial walls of the maxillary sinus and the lateral osseous nasal walls. Separation of the nasal septum from the maxilla at the nasal floor is also required. Once mobilized the maxilla may be advanced, retruded, down grafted or impacted with bone removal at appropriate locations. Once repositioned, the maxilla is stabilized to more superior osseous structures by applying bone plates and screws of titanium, titanium alloy, or bioresorbable materials.

In most instances midfacial osteotomies actually improve the patency and capacity of the nasal airway, even if the maxilla is vertically impacted because of dilatation of the liminal valve in the anterior portion of the nasal passage. Often, maxillary osteotomies also include performance of partial inferior nasal turbinectomies to reduce the size of the inferior nasal turbinates that may be hypertrophied by recurrent allergic or infectious rhinitis. Usually these procedures improve and do not impede maxillary sinus drainage.

However, during maxillary osteotomy procedures, initial significant disruption of the sinus membrane and displacement or disruption or both of the nasal mucosa takes place. The sinus cavities initially fill with blood during and after the surgery which, with the resumption of normal sinus ciliary activity and patent ostia, normally clear over the initial two or three postoperative weeks. During the initial healing period, sinus drainage is often promoted by giving the patient antihistamine medications and decongestant nasal sprays. If normal sinus drainage does not resume, potential for sinus infection exists.

Other possible causes of sinus disease after, or resulting from, maxillary osteotomy procedures include displaced, free segments of maxillary bone in the sinus not discovered and removed before the maxilla was stabilized, fragments of bone grafts or alloplastic materials, such as hydroxylapatite blocks, often used to contour or fill osteotomy sites which have become displaced into the sinus, and nonphysiologically altered nasal or sinus anatomy resulting from the surgery which obstructs the sinus ostium. Examples include nasal turbinate displacement and nasal septum deviation.

Fortunately these complications are rare. However, when they do occur the potential for disastrous results is real and includes pansinusitis, osteomyelitis, cranial abscess, surgical failure and potential loss of the osteotomized area. Patients diagnosed or suspected of having acute or chronic sinus disease after maxillary osteotomy should be immediately referred to an oral and maxillofacial surgeon—preferably the original operating surgeon for evaluation and treatment.

MUCOUS-RETENTION PHENOMENON

The mucous-retention phenomenon (i.e., mucocele, mucosal cyst) of the maxillary sinus (Fig. 19-12) is a chronic, expansile secretory cyst that is lined with respiratory epithelium. The cause of this lesion is not certain, but it probably represents a collection of mucus within the sinus membrane caused by cystic dilation of a mucous gland.

Mucoceles are not unusual within the maxillary sinus and may be seen in pantographic radiographs in 1% to 3% of the adult population. Radiographically the mucosal cyst is a homogenous, curved radiopaque area that is

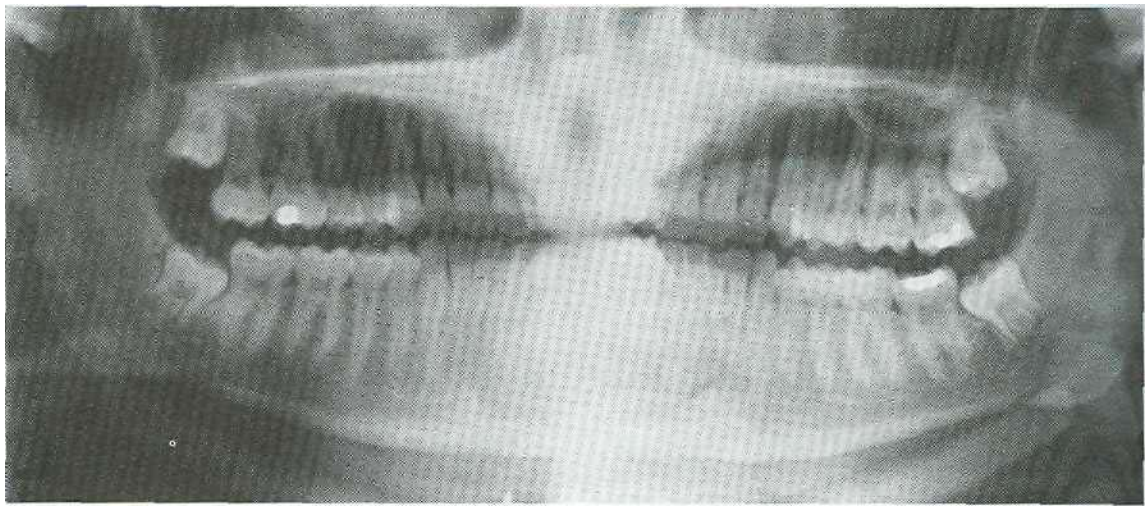


FIG. 19-12 Panoramic radiograph showing mucous-retention phenomenon in right maxillary sinus.

oval or dome shaped. The base of its attachment may be broad or narrow. The cyst has a smooth, uniform outline. Most mucosal cysts arise from the floor of the sinus. They vary in size from a few millimeters to occupying the majority of the sinus cavity.

Mucosal cysts are rarely symptomatic in the maxillary sinus and generally require no treatment beyond observation. Radiographs taken several months after diagnosis commonly show resolution of the lesion. If, however, some symptoms of sinus disease cannot be attributed to other factors, these patients should be referred to a specialist for further treatment.

Mucosal cysts should be differentiated from other conditions that produce a similar radiographic picture. These conditions include cysts of odontogenic origin, antral polyps, and benign or malignant neoplasms. On rare occasions secondary infection may produce a pyocele—a symptomatic lesion that may invade associated structures with symptoms of acute maxillary sinusitis. These patients should also be referred to an oral-maxillofacial surgeon for medical and surgical management.

OROANTRAL COMMUNICATIONS

An opening may be made into the maxillary sinus when teeth are removed and, occasionally, as a result of trauma. This sinus perforation happens particularly when a maxillary molar with widely divergent roots that is adjacent to edentulous spaces requires extraction. In this instance the sinus is likely to have become pneumatized into the edentulous alveolar process surrounding the tooth, which weakens the entire alveolus and brings the tooth apices into a closer relationship with the sinus cavity.

Other causes of perforation into the sinus include destruction of a portion of the sinus floor by periapical lesions, perforation of the floor and sinus membrane with injudicious use of instruments, forcing a root or tooth into the sinus during attempted removal, and removal of large cystic lesions that encroach on the sinus cavity.

The treatment of oroantral communications is accomplished either immediately, when the opening is created, or later, as in the instance of a long-standing fistula or failure of an attempted primary closure.

Immediate Treatment

The best treatment of a potential sinus exposure is avoiding the problem through careful observation and treatment planning. Evaluation of high-quality radiographs before surgery begins usually reveals the presence or absence of an excessively pneumatized sinus or widely divergent or dilacerated roots, which have the potential of having a communication with the sinus or causing fractures in the bony floor of the antrum during removal (Fig. 19-7). If this observation is made, surgery maybe altered to section the tooth and remove it one root at a time (see Chapter 8).

When exposure and perforation of the antrum result, the least invasive therapy is indicated initially. If the opening to the sinus is small and the sinus is disease free, efforts should be made to establish a blood clot in the extraction site and preserve it in place. Additional soft tissue flap elevation is not required. Sutures are placed to reposition the soft tissues, and a gauze pack is placed over the surgical site for 1 to 2 hours. The patient is instructed to use nasal precautions for 10 to 14 days. These include opening the mouth while sneezing, not sucking on a straw or cigarettes, and avoiding nose blowing and any other situation that may produce pressure changes between the nasal passages and oral cavity. The patient is placed on an antibiotic, usually penicillin; an antihistamine; and a systemic decongestant for 7 to 10 days to prevent infection, to shrink mucous membranes, and to lessen nasal and sinus secretions. The patient is seen postoperatively at 48- to 72-hour intervals and is instructed to return if an oroantral communication becomes evident by leakage of air into the mouth or fluid into the nose or if symptoms of maxillary sinusitis appear.

The majority of patients treated in this manner heal uneventfully if there was no evidence of preexisting sinus disease. If larger perforations occur, the patient should be referred to an oral and maxillofacial surgeon for immediate treatment.

Treatment of Long-Standing Communications

Successful treatment and closure of the oroantral communication requires extensive surgery. Aggressive antibiotic treatment is also necessary. If the fistula has developed next to the root of an adjacent tooth, closure is further complicated and, to be successful, removal of the tooth may be necessary.

Surgeons use various techniques to close oroantral fistulas or communications. Some techniques involve mobilization and rotation of large mucosal flaps to cover the osseous defect with soft tissues, the margins of which are sutured over and therefore supported by intact bone. The mucosal flaps must be designed to have a good blood supply and to alter the surrounding anatomy to the smallest extent possible. If sinus disease exists, it may be necessary to remove diseased tissues from the sinus using a Caldwell-Luc procedure through the lateral maxillary wall above the apices of the remaining teeth.

The Caldwell-Luc procedure includes the creation of an opening into the nose at the level of the sinus floor beneath the inferior turbinate to allow drainage of secretions of the sinus mucosa into the nasal cavity. This portion of the procedure is termed *nasal antrostomy.*

Other methods of closing oroantral fistulae include buccal flap advancement (Fig. 19-13), palatal flap advancement (Fig. 19-14), and advancement of both palatal and facial flaps over a metallic-foil plate. This plate is adapted to the contour of the alveolar process in the fistulous tract area and interposed between the alveolar bone and overlying mucosal flaps (Fig. 19-15 on pages 431-433). The metal foil technique provides a physical barrier over the osseous defect and also a more stable platform to support the mucosal flaps.

Regardless of the technique used, it must be remembered that the osseous defect surrounding the fistula is always much larger than the clinically apparent soft tissue deformity. Surgical planning of closure technique must be adjusted accordingly.

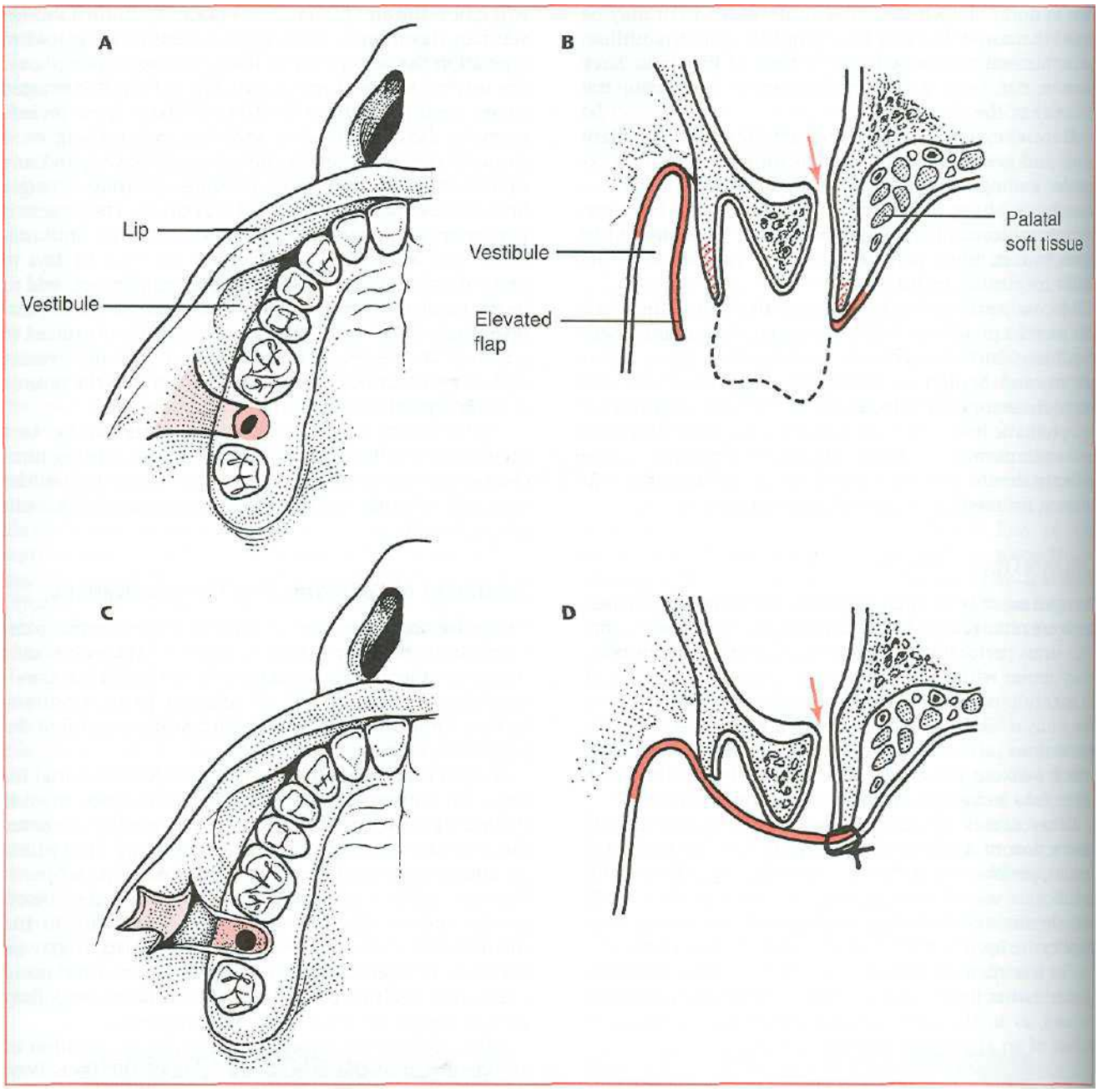


FIG.19-13 **A**, Diagrammatic illustration of oroantral fistula in second molar region of right maxillary alveolar process. Incision for closure of fistula with buccal flap advancement procedure is outlined. The fistulous tract itself will be excised. In addition, the margins of flap are wide enough to rest on bone when advanced to cover osseous defect. **B**, Elevated buccal flap. Flap is released to depth of labial vestibule. If necessary, periosteum may be incised on deep surface of flap to allow advancement of soft tissue to cover osseous defect without placing flap under tension. **C**, Advanced and sutured buccal flap. Flap must be positioned with minimal tension and its margins supported by underlying bone to ensure adequate closure of fistulous defect. **D**, Cross-section of buccal flap closure of oroantral fistula. Buccal flap has been elevated and underlying periosteum incised to improve mobility of flap.

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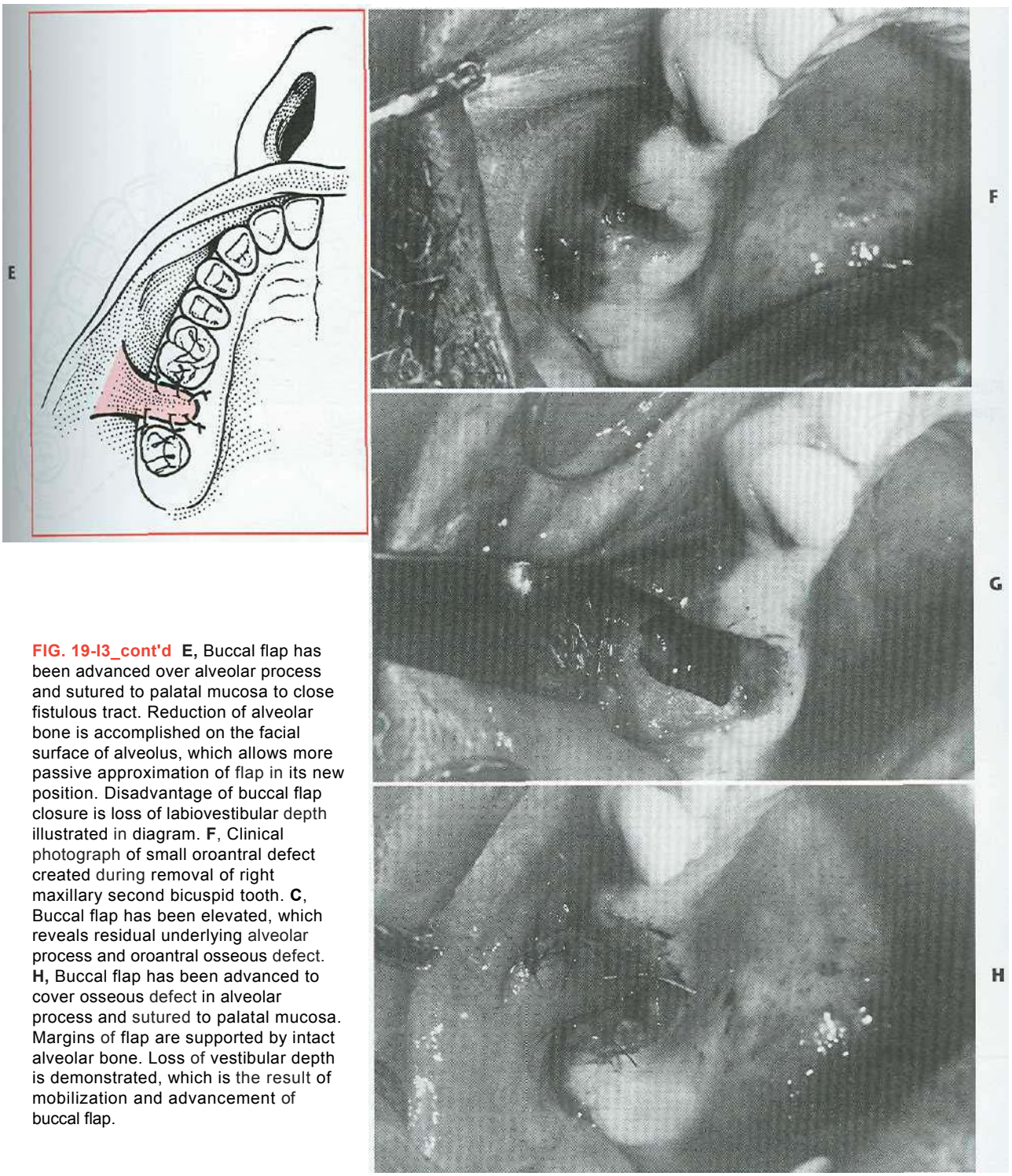


FIG. 19-I3_cont'd **E,** Buccal flap has been advanced over alveolar process and sutured to palatal mucosa to close fistulous tract. Reduction of alveolar bone is accomplished on the facial surface of alveolus, which allows more passive approximation of flap in its new position. Disadvantage of buccal flap closure is loss of labiovestibular depth illustrated in diagram. **F**, Clinical photograph of small oroantral defect created during removal of right maxillary second bicuspid tooth. **C**, Buccal flap has been elevated, which reveals residual underlying alveolar process and oroantral osseous defect. **H,** Buccal flap has been advanced to cover osseous defect in alveolar process and sutured to palatal mucosa. Margins of flap are supported by intact alveolar bone. Loss of vestibular depth is demonstrated, which is the result of mobilization and advancement of buccal flap.

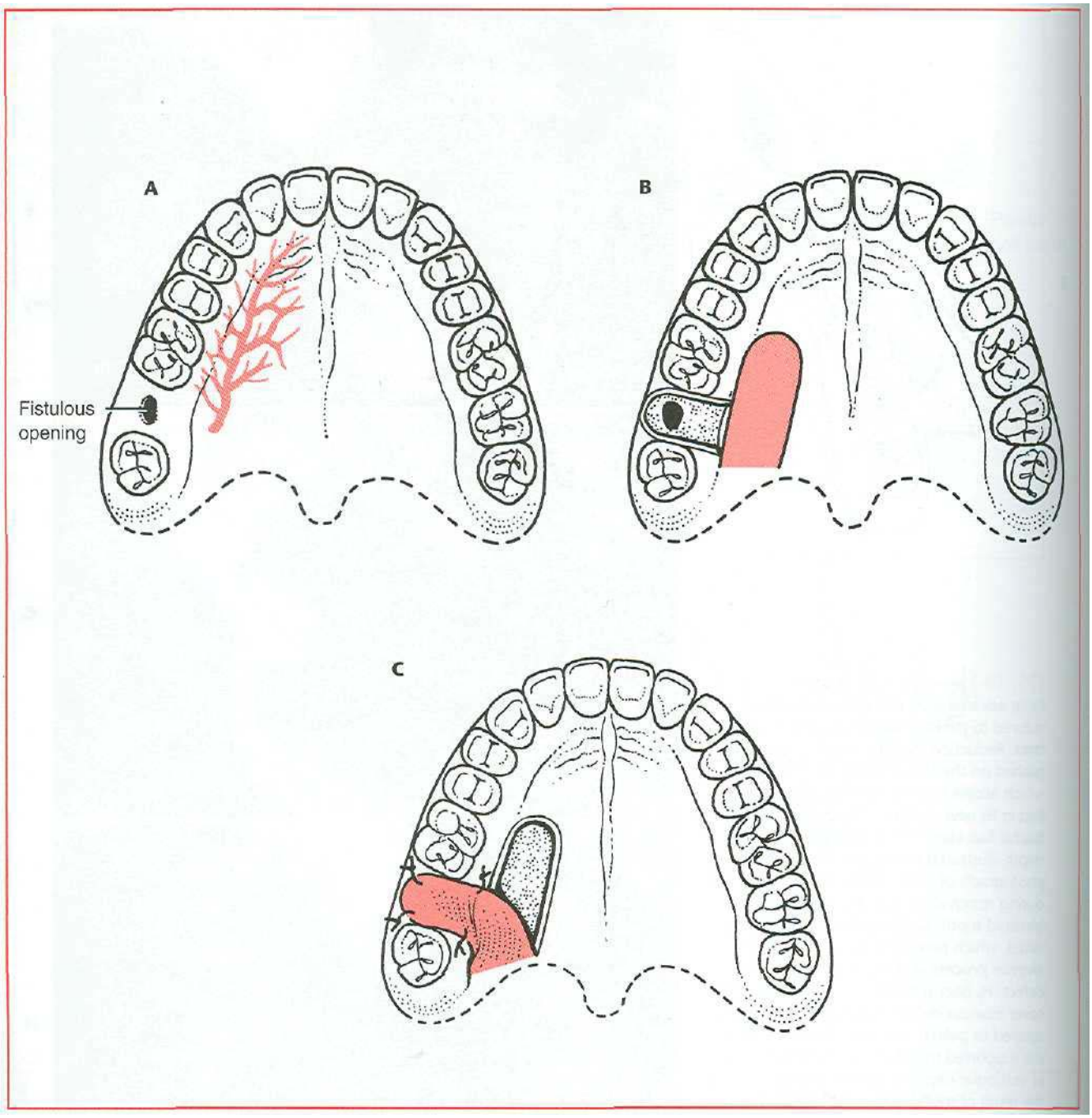


FIG. 19-14 Palatal flap closure of oroantral communications. A, Diagrammatic illustration of oroantral fistulous tract in right maxillary alveolar process in region of second molar, which is to be closed with rotation of palatal flap. Anterior palatine artery must be included in flap to provide adequate blood supply to transpositioned soft tissues. B, Soft tissues surrounding oroantral opening are excised, exposing underlying alveolar bone around osseous defect. Palatal flap is outlined, incised, and elevated from anterior to posterior. Flap should be full thickness of mucoperiosteum, should have broad posterior base, and should include anterior palatine artery. Its width should be sufficient to cover entire defect around oroantral opening, and its length must be adequate to allow rotation of flap and repositioning over defect without placing undue tension on flap. C, Palatal flap has been rotated to cover osseous defect in alveolar process and sutured in place. Exposed bone on palate, which remains after rotation of flap, will heal by secondary intention with minimal discomfort to patient and little or no alteration in normal soft tissue anatomy.

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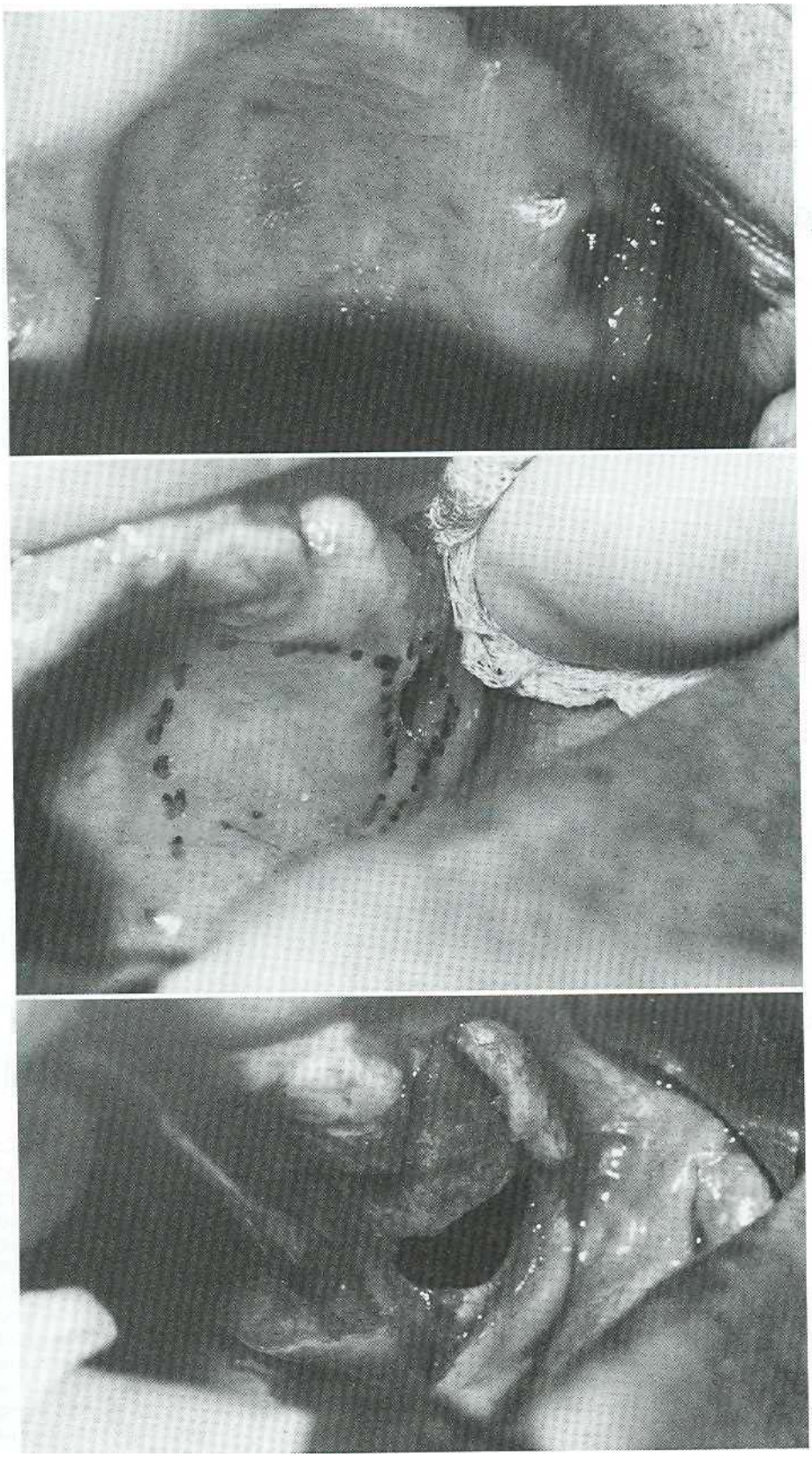


FIG. 19-14—cont'd D, Large oroantral communication in left maxilla that developed after removal of second molar tooth. E, Palatal flap outlined. Flap is posteriorly based and receives its blood supply from anterior palatine neurovascular bundle. Width of flap is much larger than clinical oroantral communication. F, Palatal flap is elevated and readied for transposition laterally to cover osseous oroantral defect. Buccal mucosa has also been elevated to facilitate suturing of flap. Large size of osseous defect is demonstrated.

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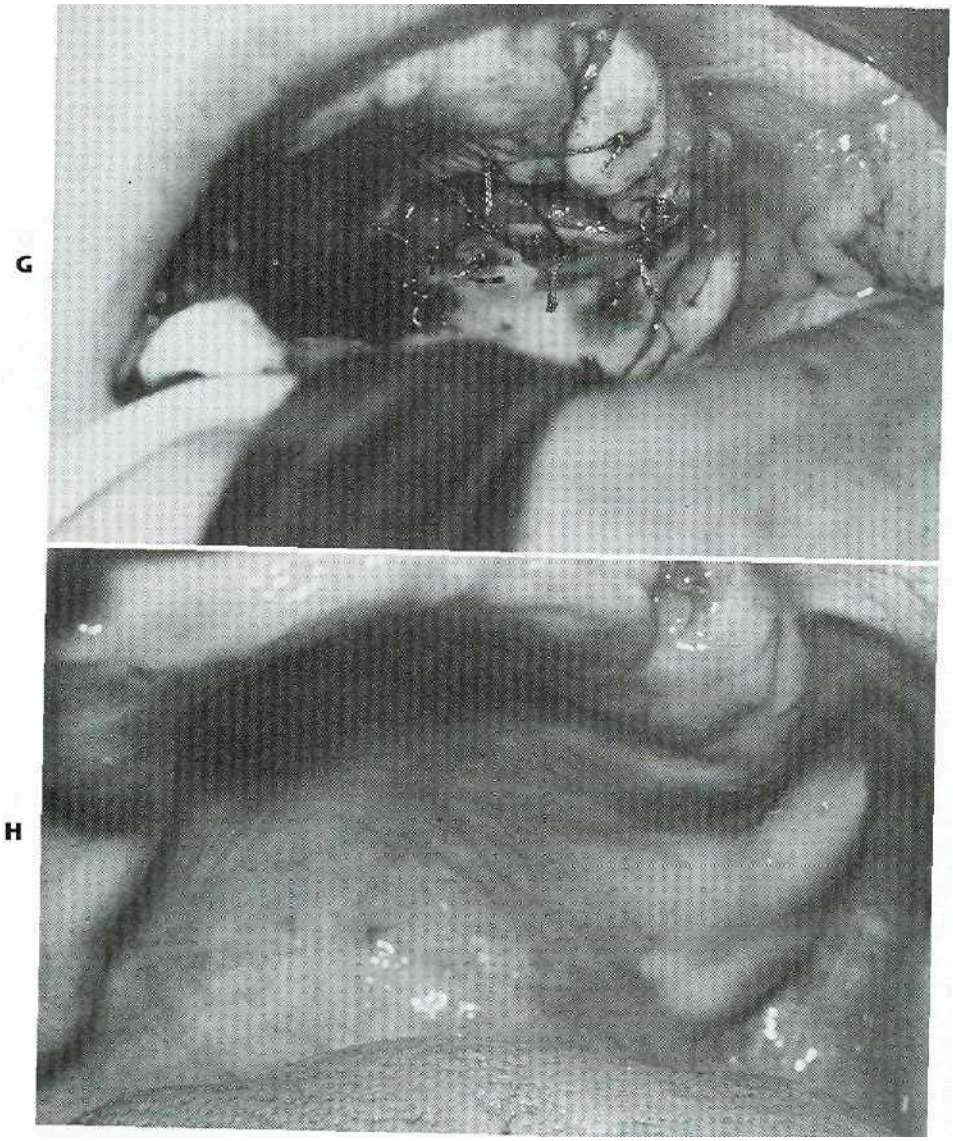


FIG.19-14-cont'd **G**, Palatal flap has been rotated and sutured in Place. Osseous defect is well covered. Small area of exposed bone near palatal midline will heal by secondary intention. **H**, Well-closed oroantral communication 4 weeks after rotation of palatal flap Vestibular depth is maintained with this procedure. Metallic-foil closure of oroantral communications

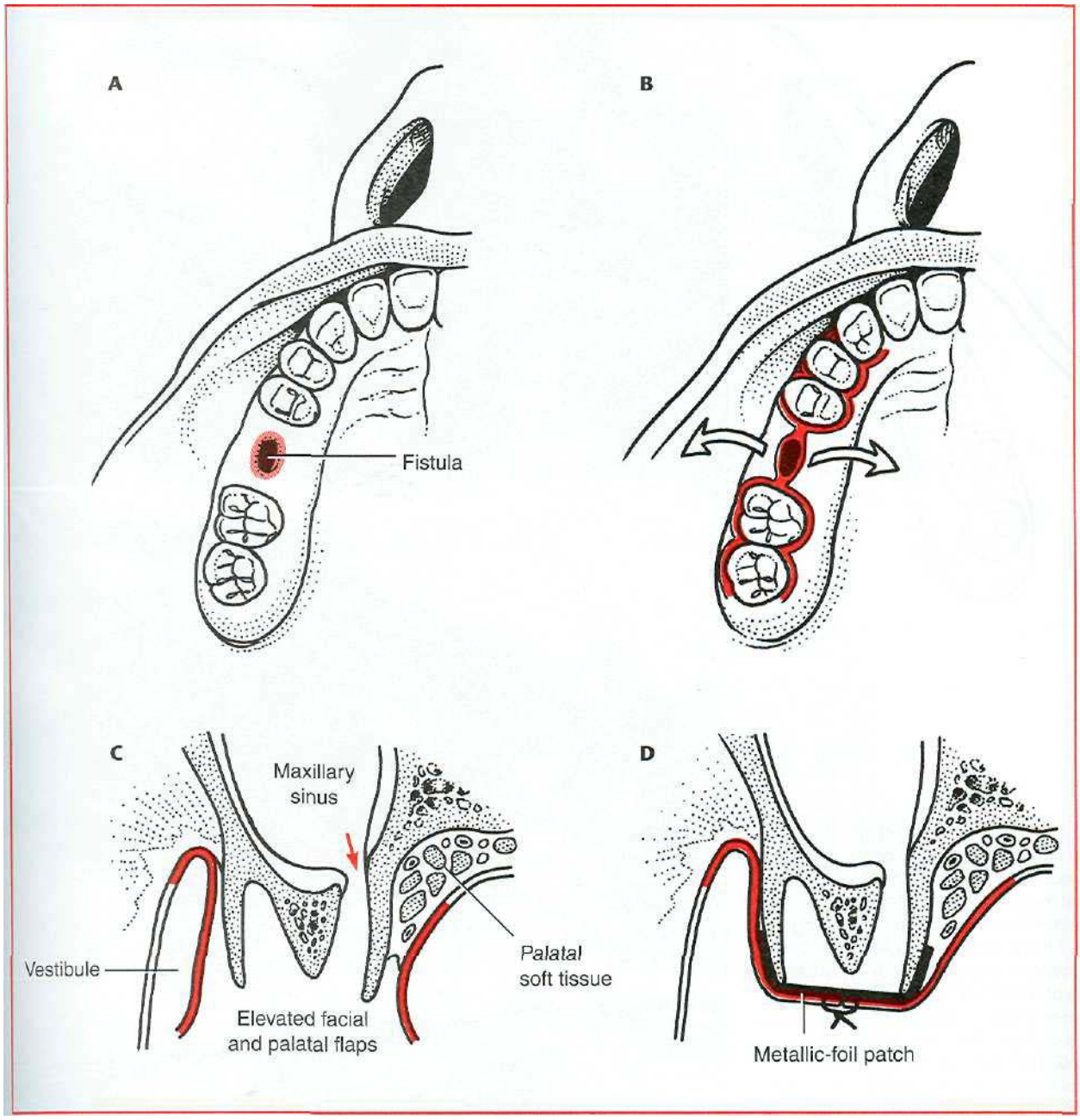


FIG. 19-15 Metallic-foil closure of oroantral communications. A, Diagrammatic illustration of oroantral fistula in right maxillary alveolar process in region of missing first molar tooth, which is to be closed with subperiosteal placement of metallic-foil "patch." B, Both facial and palatal mucoperiosteal flaps are developed. When elevated, these provide ample exposure of underlying alveolar process and fistulous tract. Fistulous tract is excised. Osseous margins must be exposed 360 degrees around bony defect to allow placement of metallic-foil patch beneath mucoperiosteal flaps. Flap is supported on all sides by underlying bone. C, Metallic-foil patch has been adapted to cover osseous defect and positioned between alveolar process and overlying buccal and palatal mucoperiosteal flaps. Foil should be supported on all its margins by sound underlying bone. Mucoperiosteal flaps have been repositioned and sutured over foil. D, Cross-sectional diagram of metallic-foil closure technique. Both buccal and palatal mucoperiosteal flaps are elevated to expose osseous defect and large area of underlying alveolar bone around oroantral communication.

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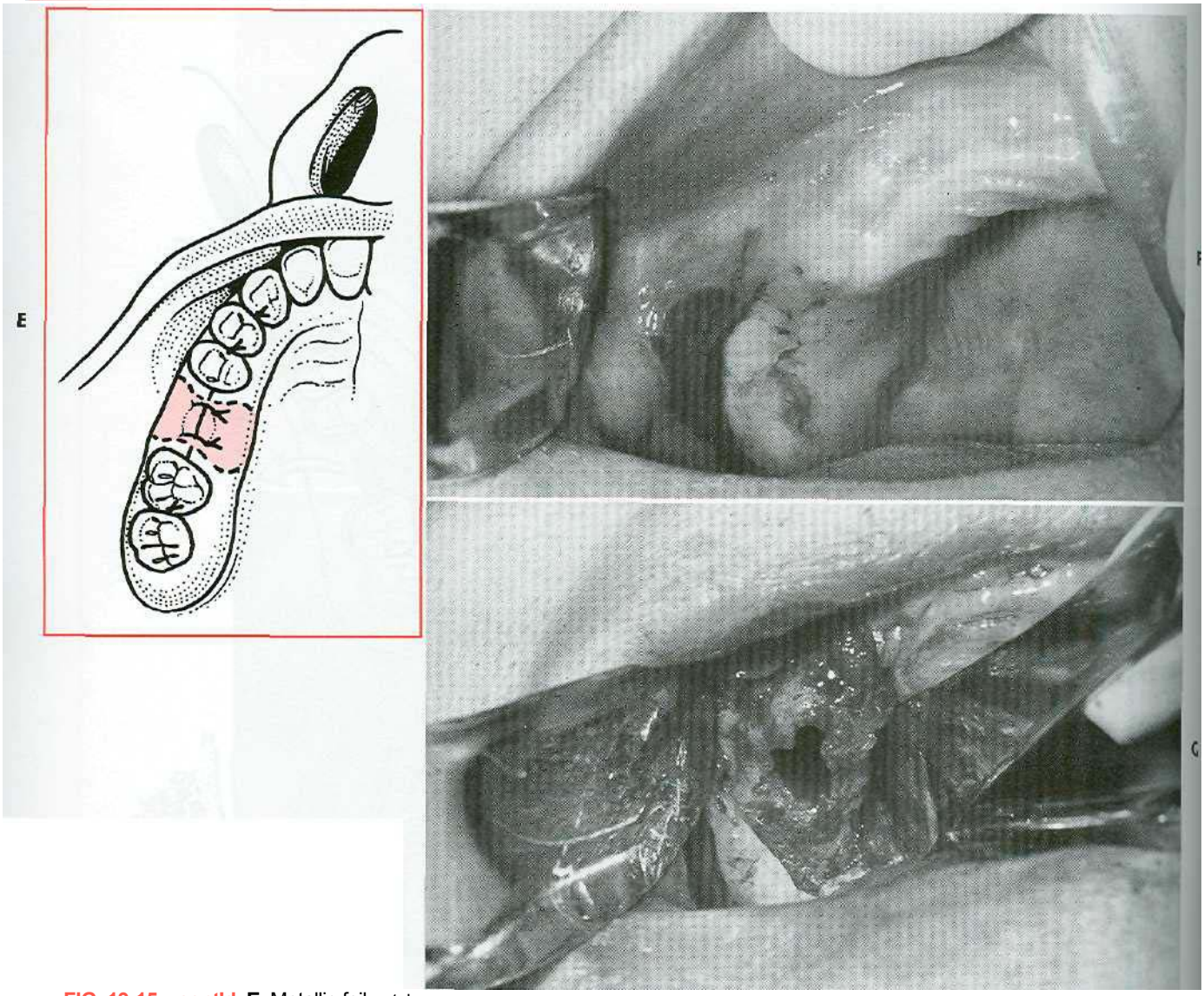
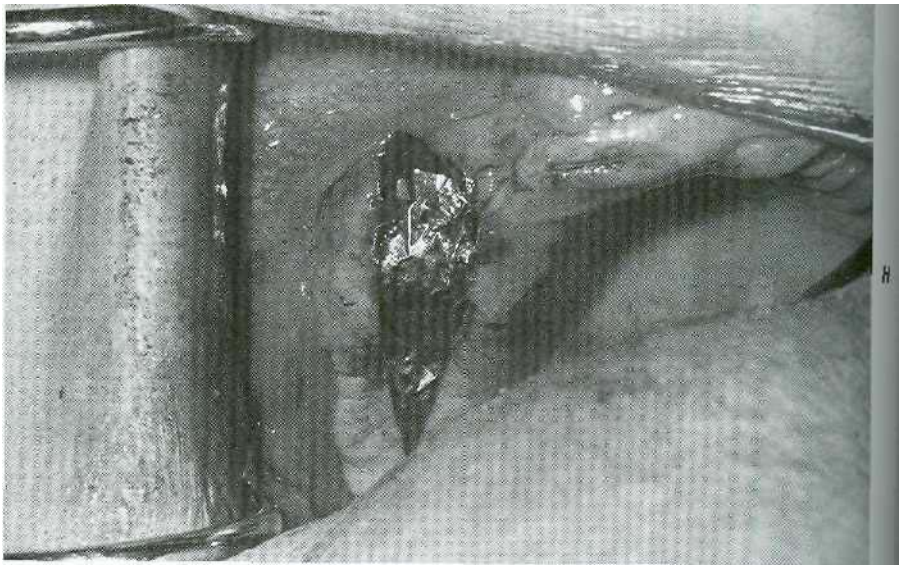


FIG. 19-15—cont'd **E,** Metallic-foil patch has been positioned between alveolar process and deep surface of buccal and palatal mucoperiosteal flaps. Foil is entirely supported on its margins by underlying bone. Mucoperiosteal flaps are repositioned and approximated over foil. F, Oroantral fistula of several weeks' duration in right posterior maxilla that developed secondary to removal of retained first molar tooth root. C, Elevation of large buccal and palatal mucoperiosteal flaps has been completed. Large size of exposed alveolar osseous defect is demonstrated. H, Titanium foil patch has been adapted over defect in alveolar process. Foil is inserted beneath facial and palatal mucosa and covers minimum of 5 mm of alveolar bone on all sides of osseous defect.

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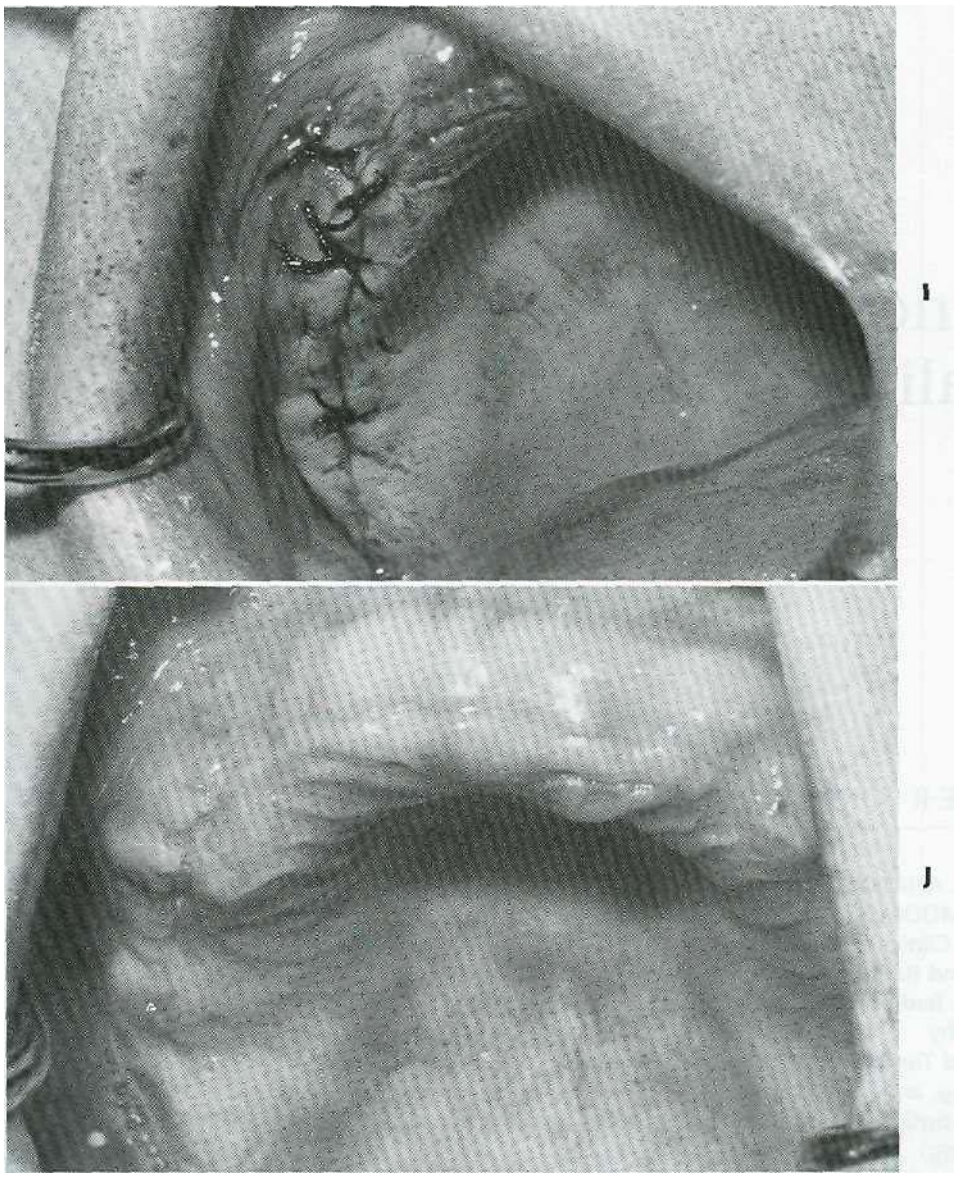


FIG. 19-15—cont'd I, Palatal and buccal mucosal flaps are sutured in place over metallic-foil patch. Flaps are minimally advanced, and no real attempt is made to close mucosa primarily over foil. J, Four weeks after closure of right maxillary oroantral defect with the foil patch procedure. Area is well healed. Normal vestibular depth and palatal anatomy are maintained.

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