Epistaxis

Epistaxis is best classified according to its location: anterior, superior, or posterior. *Anterior* bleeding occurs in Little's area on the anterior septum, from either a branch of the anterior ethmoid artery, septal branch of the superior labial artery, septal branch of the sphenopalatine artery, or the greater palatine artery. *Superior* bleeding occurs from either the anterior ethmoid artery, posterior ethmoid artery, or the superior nasal branch of the sphenopalatine artery. *Posterior* epistaxis results from rupture of the sphenopalatine artery or one of its branches.

**Etiology**

**Trauma.** Externally, any displacement of the cartilaginous or bony nasal framework may be compounded by a tear in the mucous membrane and result in epistaxis.

Internal trauma may result from sneezing, excessive nose-blowing, or nose-picking.

**Infection.** Acute inflammation of the nasal mucous membranes may lead to epistaxis. The superficial erosion and exposure of blood vessels, coupled with the irritation of nose-blowing, often results in nosebleeds. This type of epistaxis is usually anterior and is easily controlled. Associated with chronic rhinitis, however, it can be most troublesome. It usually occurs in areas where there is crusting and ulceration of a mucous membrane, and often accompanies atrophic rhinitis or a septal perforation.

**Pressure Changes.** Epistaxis is not infrequently associated with the atmospheric pressure changes occurring during air or submarine travel and is more common in people living at higher altitudes than in those living in lower altitudes because of lower atmospheric pressure and lack of moisture.

**Foreign Body.** Epistaxis frequently is due to a foreign body in the nasal cavity. This is most common in children and mentally deranged patients. Nasal stuffiness or obstruction, accompanied by an odoriferous purulent discharge, is a manifestation of an intranasal foreign body.

**Neoplasms.** Benign lesions, such as angiofibroma, and malignant lesions are frequently complicated by epistaxis. The bleeding occurring with angiofibroma can be serious and difficult to manage. Each patient with epistaxis should be carefully examined to exclude the possibility of either benign or malignant neoplasm.

**Familial Telangiectasia (Rendu-Osler-Weber Disease).** The bleeding occurring with this disease usually begins during middle life. It can become so frequent and severe that it dominates the patient's life completely. The small cherry-red telangiectatic spots occur
anywhere in mucous membrane or skin, but are most frequently found in the nasal cavity, mouth, pharynx, and skin of the face (see section on septal dermoplasty).

**Systemic Diseases.** In most cases the exact cause of epistaxis is obscure. Epistaxis often occurs in patients with systemic diseases such as hypertension, arteriosclerosis, anemia, leukemia, deficiency states, hepatic cirrhosis, and chronic nephritis.

**Vicarious Menstruation.** Vicarious menstruation should be expected when epistaxis is experienced repeatedly during menstruation.

**Coagulation Defects.** The diagnosis of bleeding due to coagulation defects is made by means of tests such as blood counts, blood smears, determination of bleeding and clotting times, and platelet counts. Pseudohemophilia occurs more frequently in females than in males. In epistaxis due to this condition the only abnormality found is that of prolongation of the bleeding time.

**Anterior Epistaxis**

It is fortunate that anterior bleeding is the most common type of epistaxis for it is the easiest to control. Local measures to produce reflex vasoconstriction are helpful. These include placing an icebag on the back of the patient's neck, putting a wad of paper or cotton beneath his upper lip, and continuous irrigation of the nasal passage with ice water. Quite often anterior epistaxis will cease spontaneously if the patient remains calm and in a sitting position with his head slightly forward. He is instructed to breathe through his mouth and squeeze both nostrils shut. If these measures are not effective, a piece of moist cotton is placed in the anterior nasal cavity and compressed against the bleeding point by applying external pressure.

**Cauterization.** Cauterization may be necessary to control either a prolonged, solitary or repeated episode of anterior epistaxis.

Anesthesia is easily obtained by inserting 4% cocaine-impregnated cotton strips into the nasal cavity and waiting for 5 to 10 minutes. The vasoconstricting action of the cocaine slows down or controls the epistaxis which will facilitate the cauterization. Other topical anesthetic agents, such as 4% Xylocaine or 2% Pontocaine, with epinephrine solution added can be used as substitutes for the cocaine solution.

If it is impossible to control the bleeding by anterior packing, especially when dealing with an arteriosclerotic vessel, the area adjacent to the bleeding point should be injected with a local anesthetic agent, combined with epinephrine solution, prior to cauterization. Injection should be made with a #25 or #27 needle.

**Chemical Cauterization.** A silver nitrate stick is the most commonly used implement for chemical cauterization for epistaxis, but this provides superficial cauterization, which may not be efficient. A small chromic acid bead on the end of a wire produces excellent cauterization. A tiny cotton pledget dipped in 50% trichloroacetic acid solution is also very effective. The chromic acid bead is made by first heating a wire applicator so that it becomes cherry-red and then dipping it into chromic acid crystals. It is important that the chemical be
placed only at the site of the bleeding; it should not be applied when the bleeding is profuse. The application of a dry cotton swab immediately after the cauterization prevents distribution of the chemical to adjacent areas of mucous membrane.

**Electrocautery.** Should chemical cauterization fail, the electrocautery may be utilized. Most types of instruments work well. The red hot tip cautery does not stick to the eschar produced as readily as do other types of electrocautery. Bleeding tends to occur as the eschar is pulled away by the cautery tip. Following cauterization, the patient is instructed to avoid straining, nose-blowing, and sneezing for a few days, and to insert a pea-sized piece of petroleum jelly on the septum, just behind the columella, each morning and evening for one week.

**Packing.** One-inch wide petrolatum-strip packing may be inserted into the anterior nasal cavity for treatment of troublesome anterior bleeding. In order to prevent its passing into the nasopharynx, it is important to secure the end of the packing in place externally with a piece of tape. The anterior packing should remain in place for from one to 3 days. Hemostatic agents, such as Gelfoam, oxidized cellulose, and topical thrombin, are of value when placed directly over the bleeding point. If the anterior packing is to remain in place for a number of days it is best to use antibiotic-impregnated iodoform gauze rather than petrolatum gauze, to help prevent secondary infection and odor.

**Superior Epistaxis**

Antero-superior bleeding usually emanates from a medial or lateral branch of the anterior or posterior ethmoid artery. Postero-superior epistaxis is likely to come from a branch of the sphenopalatine artery. If the bleeding point can be seen it is cauterized after packing with a topical anesthetic agent and after a vasoconstrictor, as has been used for control of anterior bleeding. If the bleeding point cannot be located, then anterior packing must be utilized.

**Anterior Packing.** The patient is placed in a sitting position with his head tilted slightly backward and supported either by an assistant or a head rest. With a nasal speculum and bayonet forceps, iodoform gauze, which has been impregnated with antibiotic ointment, is carefully packed into both nasal cavities. The packing is begun posterosuperiorly and continued in a forward direction. The anterior ends of each strip of packing are tied together so that they will not be lost in the nasopharynx. The anatomy of the nose is such that this packing tends to become displaced inferiorly. Therefore, the inferior nasal cavity is packed a finger-cot packing. If both nasal cavities are packed, a piece of rubber catheter is placed through the finger-cot packing, into the posterior nasal cavity, to prevent annoying interference with eustachian tube function during swallowing. This packing should remain in place for from 3 to 5 days.

**Ligation of the Ethmoidal Arteries.** Persistent superior bleeding is, on occasion, best treated by ligation of the anterior and posterior ethmoid arteries. These arteries are ligated just lateral to the point where they enter the medial wall of the orbit.

The anterior and posterior ethmoid foramina are situated in, or adjacent to, the frontoethmoidal suture line (between the orbital plate of the frontal bone and the lamina
papyracea). In some persons the foramina may be situated slightly above this suture line. According to Kirchner and associates the anterior ethmoid foramen is between 14 and 18 mm behind the maxillo-lacrimal suture line. The posterior ethmoid foramen is between 4 and 7 mm anterior to the optic foramen. The distance between the anterior and posterior ethmoid foramina averages 10 mm.

An external ethmoid incision is used for exposure. The lacrimal sac and orbital perioisteum are retracted laterally as has been described for external ethmoidectomy. The suture line between the orbital plate of the frontal bone and the lamina papyracea can easily be found. This is followed posteriorly until the anterior ethmoid artery is located. There are a number of ways to deal with the artery. A #3-0 silk suture can be looped around it with a hook-shaped needle carrier. A second method is that of cauterizing the artery just as it enters the anterior ethmoid foramen. This method is usually rapid and effective, except when the artery ruptures causing troublesome bleeding. A third method utilizes self-locking hemostatic clips, which are applied after the artery is placed under tension by laterally retracting orbital perioisteum. The anterior ethmoid artery is divided so that the posterior ethmoid artery can also be identified and ligated. Closure and postoperative care are the same as described for external ethmoidectomy.

### Posterior Epistaxis

Posterior epistaxis can be severe, frightening, and difficult to control. It is the result of rupture of the sphenopalatine artery or one of its branches. Usually the patient gives a history of blood flowing profusely into the pharynx, as well as from the anterior nares. Much blood can be lost in a relatively short period of time. Often, much of this blood is swallowed, and the patient reports vomiting "coffee-ground" material.

Unless the patient shows signs of shock, he is placed in the sitting position. The nasal cavities are packed with cotton strips which are impregnated with 4% cocaine, or a topical anesthetic agent, plus epinephrine solution (1:1000). It is important to place these strips behind both the middle and inferior turbinates. It may be necessary to fracture the middle or inferior turbinate medially in order to find the site of hemorrhage. If the bleeding site can be seen, it is worth the effort to attempt cauterization or to cover the area with a pledget of oxidized cellulose. The pledget can usually be wedged between the turbinate and the lateral nasal wall, in the inferior or middle meatus. If the bleeding cannot be controlled by such measures, then it is necessary to use anterior and posterior packing.

### Anteroposterior Packing

The patient is sedated with either morphine or Demerol as soon as the decision to employ anteroposterior packing is made. Both the nasal cavity and soft palate are anesthetized topically with 2% Pontocaine or 4% cocaine solution. It is most important to tell the patient what is being done, for the experience of having postnasal packing inserted can be a frightening one. A soft rubber catheter is placed in the nasal cavity on the side of the epistaxis and advanced until it appears in the pharynx. The catheter is grasped with a bayonet forceps, or a Kelly clamp, and delivered through the mouth. One set of strings from the posterior pack is tied to the end of the catheter protruding from the mouth. The catheter is withdrawn from the nose, bringing the strings to the nasal orifice. The operator tenses these strings with one hand, while delivering the posterior pack into the nasopharynx with the index finger of the other hand, or with a Kelly clamp. An assistant can
hold the strings protruding from the nasal orifice while the anterior packing is being inserted. This packing consists of one long strip of 1-inch antibiotic-impregnated iodoform gauze. One end is packed firmly against the anterior aspect of the posterior pack and then the entire nasal cavity is carefully filled with the gauze strip. The two strings protruding from the nostril are tied over a cotton dental roll or a rolled-up 2 x 2-inch gauze pad to pull the posterior pack forward and thereby exert anterior pressure against the intranasal packing. The strings protruding from the posterior aspect of the pack into the pharynx and out the mouth are cut flush with the uvula. It is not necessary to bring these out through the mouth and tape them to the cheek. If the uvula becomes excessively edematous, it should be incised.

A patient with an anteroposterior pack is kept in bed in a semi-sitting position for at least 24 hours. His feet, legs, and thighs are encased in elastic stockings. An ice collar is applied and ice packs are placed at the side of his nose. Tranquilizers and medication for relief of pain are given as needed. A soft diet is prescribed, and laxatives are administered to prevent constipation. As a general rule it is best to give antibiotics when anteroposterior packing is used in order to combat the inevitable sinusitis. Lost blood is replaced, as indicated, by transfusions. Daily hemoglobin and hematocrit determinations are essential. A general evaluation of the patient is conducted in order to detect any underlying cause of the epistaxis.

There are many disadvantages to anteroposterior packing. The patient is extremely uncomfortable, for mouth breathing results in a dry and sore throat. Deglutition is difficult. Complicating sinusitis often occurs. With the packing in place, blood may ascend by way of the nasolacrimal duct, and exit from the ocular punctum, or by way of the eustachian tube, causing hematotympanum and rupture of the tympanic membrane. Even after all this the bleeding may recur when the nasal packing is removed.

**Transantral Ligation of the Internal Maxillary Artery.** Posterior epistaxis from the sphenopalatine artery can be a serious medical problem, especially when bleeding persists during or following the removal of anterior and posterior nasal packing.

Ligation of the external carotid artery is not effective in many cases of posterior epistaxis. Ligation of the internal maxillary artery, on the other hand, has proven very effective for the control of sphenopalatine artery hemorrhage (Malcomson; Chandler and Serrins).

**Anatomy of the Third Division of the Internal Maxillary Artery.** The internal maxillary artery is the larger of the two terminal branches of the external carotid artery. It arises behind the neck of the mandible and is divided into three parts: the mandibular, pterygoid, and pterygopalatine (third division). The pterygopalatine division follows a tortuous course as it traverses the pterygomaxillary fossa where it gives off seven branches.

**Posterosuperior Alveolar Artery.** This vessel descends on the tuberosity of the maxilla and divides into numerous branches, some of which enter the alveolar canals to supply the molar and premolar teeth and the lining of the maxillary sinus, while others continue forward on the alveolar process to supply the gums. The posterosuperior alveolar artery may share a common trunk with the infraorbital artery.
**Lesser Palatine Artery.** In our cadaver dissections, the lesser palatine artery was found to originate from the superior aspect of the pterygomaxillary artery, directly medial to the origin of the posterior superior alveolar artery. It descends parallel to the greater palatine artery, supplying the posterior upper alveolus, gums, and hard and soft palate.

**Nasal Accessory and Superior Pharyngeal Arteries.** These arteries may have a common origin. The nasal accessory artery supplies the floor of the nose, inferior meatus, inferior turbinete, and lower middle meatus. The superior pharyngeal artery is distributed to the upper pharynx and the orifice of the eustachian tube.

**Infraorbital Artery.** The infraorbital artery passes anteriorly along the floor of the orbit, within the infraorbital canal, to emerge externally through the infraorbital foramen. It has numerous branches. Within the infraorbital canal, it supplies the inferior rectus and inferior oblique muscles, and the lacrimal sac. Anteriorly, its branches descend through the alveolar canals to supply the upper canine, and incisor teeth and the mucous membrane of the maxillary sinus. Its terminal branches supply the tissues of the midface.

**Arteries of the Foramen Rotundum and Pterygoid Canals.** These arteries may arise separately or together in a common trunk. If they share a common trunk, they divide and pass into their respective foramina and are distributed to the enclosed nerves and connective tissues.

**Greater Palatine Artery.** The greater palatine artery descends through the pterygopalatine canal with the greater palatine branch of the sphenopalatine nerve, emerges from the greater palatine foramen, and extends forward on the medial aspect of the hard palate to the incisive canal. The terminal branch passes through this canal to anastomose with the branches of the sphenopalatine artery. Other branches are distributed to the gums, palatine glands, oral mucosa, soft palate, and palatine tonsils.

**Sphenopalatine Artery.** The sphenopalatine artery is the terminal branch of the internal maxillary artery. It passes through the sphenopalatine foramen into the nasal cavity behind the posterior tip of the middle turbinate. Here it gives off the posterior lateral nasal branches, which extend forward over the meatuses and turbinates to anastomose with branches from the ethmoid and palatine arteries and to assist in supplying the maxillary, ethmoid, and sphenoid sinuses. The terminal branches of the sphenopalatine artery cross the undersurface of the sphenoid and end on the nasal septum as the posterior septal arteries, which anastomose with the anterior and posterior ethmoids, and superior labial and greater palatine arteries, to supply the floor of the septum and the roof of the nose.

**Surgical Technique of Transantral Ligation of the Internal Maxillary Artery.** The operation may be performed with the patient under either general or local anesthesia. When local anesthesia is the choice, 2% Xylocaine with added epinephrine is injected into the gingivobuccal sulcus and around the infraorbital nerve.

A curved needle is inserted 2 cm in the greater palatine foramen, and 2 cc of the local anesthetic is slowly injected into the canal and pterygomaxillary fossa.
A Caldwell-Luc incision is used. The periosteum is elevated from the anterior wall of the antrum in the region of the canine fossa. The antrum is entered by using a curette, chisel, or rotating bur. As much of the anterior wall of the antrum is removed as is possible without damaging the infraorbital nerve. This can be accomplished with Kerrison forceps, but is best done with a rotating bur. A cocaine pack is placed in the antrum for a few minutes to further anesthetize the antral mucosa and to decrease bleeding. A mucosal flap, based laterally or inferiorly, is elevated from the posterior wall of the antrum. A self-retaining retractor is applied.

The surgical microscope, with a 300-mm lens, should be used during the remaining dissection. The thin posterior wall is broken through with a curette or small chisel. The periosteum is carefully separated from the posterior sinus wall, which in turn is removed with Hajek bone-cutting forceps. It is important to extend this bony dissection as far medially as is possible, for the vidian canal is often found directly posterior to the medial wall of the antrum. There are a number of small blood vessels directly underneath the periosteum covering the pterygomaxillary fossa. The periosteum is best opened by using a spatula blade with electrocoagulation current to accomplish the cruciate incisions. The four flaps thus created are easily elevated, exposing the underlying adipose tissue.

Pulsations of the internal carotid artery can often be seen, giving the surgeon some indication as to the location of this artery. Adipose tissue is carefully removed with dissectors, alligator and cup forceps, and suction tips, all especially designed for this purpose. As soon as the main artery is identified, it is elevated with an artery hook so that its branches may be more readily dissected free.

The sphenopalatine artery is retracted anteriorly with an artery hook and doubly clipped. I have found the various nonlocking hemostatic clips to be unsatisfactory, for they are gradually reopened by the strong pulsations of this artery. If possible, the infraorbital and greater palatine arteries should be identified so that the arterial occlusion can be accomplished medial to their origin.

It is not necessary to section the artery when using the self-locking clips. The sphenopalatine artery can be ligated with #3-0 silk suture material if the self-locking clips and its applicators are not available. The suture is passed beneath the artery with a ligature carrier, or small, curved or right-angle hemostat, and tied by hand or with the aid of a long, thin needle holder.

The posterior central mucosal flap is reflected over the pterygomaxillary fossa and covered with Gelfoam. Any intranasal packing is removed. Slight bleeding should not be of concern, for it will cease spontaneously. A nasoantral window is added for drainage only if bleeding has been a problem throughout the operation or if the patient has had intranasal packing in place for sufficient time for sinusitis to become a complication. If a nasoantral window is fashioned the antrum is packed with antibiotic-impregnated iodoform gauze, which is removed on the second or third postoperative day. The Caldwell-Luc incision is closed with loosely tied catgut sutures.

Postoperative Care. Postoperative care should include the administration of antibiotics, placing the patient in the semi-sitting position, and the application of an ice pack over the
patient's face to prevent edema and ecchymosis. The ice pack should be applied as soon as the patient reaches the recovery room. It should remain in place for 24 hours.

**Septal Dermoplasty for Hereditary Hemorrhagic Telangiectasia**

In many cases the severe recurrent epistaxis associated with Rendu-Osler-Weber disease can be controlled by skin-grafting both sides of the anterior nasal septum as outlined by Saunders. The epistaxis associated with this systemic disease can be a most severe problem. In some cases, daily hemorrhages dominate the patient's entire existence. Gastrointestinal bleeding and hemorrhage from the lips, tongue, and gums also occur.

The telangiectatic lesions may be found on any epithelial surface. They are bright red, usually about a millimeter or two in diameter, slightly raised, and blanch with pressure. Microscopically the vessels in the telangiectatic lesions are superficial, thin-walled, and void of muscular or elastic tissue. Thus bleeding with minimal trauma occurs with a lack of spontaneous cessation of hemorrhage.

**Septal Dermoplasty Technique.** Approximately 30 cc of 1% Xylocaine solution are required to anesthetize the donor site on the thigh for a split-thickness skin graft. The upper lip, columella, nasal septum, and nasolabial sulcus are also anesthetized with 1% Xylocaine solution.

A split-thickness skin graft, approximately 2.5 by 4 inches in size and 0.016 to 0.020 inch in thickness, is sufficient to cover both sides of the anterior nasal septum and the floor and tip of the inferior turbinate. The skin-graft donor site is covered with petrolatum gauze, or Telfa or Owen's silk, and then with an overlying pressure dressing.

A nasolabial incision is made to acquire better exposure of the anterior nasal cavity. This incision should extend slightly into the floor of the nose. One suture through the ala, weighted with a heavy hemostat, serves for retraction.

A vertical postcolumellar incision is made anterior to the mucocutaneous junction. This incision is made along the full vertical dimension of the anterior nasal septum, but not through mucoperichondrium. The mucous membrane is resected, preserving the perichondrium, with a knife, scissors, and sharp curettes. It is essential that all mucous membrane be removed so that mucus-secreting epithelium will not be present under the skin graft. Bleeding is controlled with cautery and topical epinephrine solution.

The skin graft is halved, one half to be used for the anterior third of the nasal septum, the other for the anterior portion of the lateral wall and inferior turbinate. The skin graft is secured in place anteriorly with #4-0 chromic catgut sutures and then pushed posteriorly so that it covers all areas which have been denuded of mucous membrane. The graft may be tacked in place with a few additional sutures if necessary. If indicated, the operation is repeated on the contralateral side. The nasal cavity is loosely packed with antibiotic-impregnated iodoform gauze. The nasolabial incision is approximated subcutaneously with #4-0 chronic catgut and the skin is closed with #5-0 dermal suture material.
The intranasal packing remains in place for 4 or 5 days. The nasolabial skin sutures are removed after one week. The patient is instructed to apply petrolatum or mineral oil to each side of the nose several times a day. The nasal cavity should be examined once a week, at which time crusts and excessive skin graft are removed. Instructions for long-term nasal care are necessary, for some degree of crusting will persist. This can be controlled with saline irrigations and the application of petrolatum.

**Nasoseptal Perforation**

The symptoms associated with nasoseptal perforation can be distressing. The crusting and epistaxis accompanying a large perforation are usually controlled by topical agents which effect lubrication. On the other hand, the noisy respiration (whistle) produced by the small anterior perforation is quite annoying for the patient and for those who surround him. It is usually this symptom which prompts the patient to seek aid.

The causes of septal perforations have been thoroughly reviewed by Seeley. The structural abnormality consists of a bilateral mucosal incompetence, coupled with the absence of septal cartilage, and, at times, bone. Most commonly the limits (margins) of the perforation are covered with mucous membrane which has extended over the exposed cartilage. Chemical agents, such as those used with cauterization of blood vessels in the treatment of epistaxis, are probably the most common cause of perforations. Metabolic disorders, particularly diabetes mellitus, are predisposing factors to septal perforations because of impaired vasculature and greater susceptibility to infection. Infection, either directly by necrosis of tissue or indirectly following incision and drainage of a septal abscess, can result in a septal perforation. Trauma to the septum - accidental, iatrogenic (nose-picking), or surgical - occasionally results in a septal perforation. Congenital perforations, although rare, have been reported.

Ballenger has stated that large nasoseptal perforations are not amenable to surgery. Small defects, usually 1.5 cm in diameter or less and located anteriorly in the septum, are the most common and happily the easiest to repair. As would be expected, there have been many techniques introduced for the repair of these perforations. Most methods utilize unilateral or bilateral sliding flaps of septal mucous membrane.

After the inner rim of mucous membrane has been removed, simple primary closure of septal perforation with through and through sutures, usually results in failure.

Hazeltine's method, as described by the Ballengers, represents the principle of sliding mucosal flaps. With small perforations, the advantage of this procedure is that both sides are covered; thus the chances for a permanent closure are greatly enhanced. A unilateral septal flap, described by Berson, has been noted to have a rather high incidence of failure.

Autogenous septal cartilage grafts have been used to lend support to the septal flaps. Central necrosis and curling of the graft is described by Goldman, and by Huffman and Lierle. These authors noted that cartilaginous grafts, inserted during submucous resection of the nasal septum, underwent resorption as a late complication. Missal reported a rejection of five out of seven Ivalon septal implants. He speculated that the rejection was secondary to specific hyperimmunity of nasal tissue to foreign substances. Behrman reported three cases
of fascia lata graft in which the fascia lata was sandwiched between septal mucosal flaps. In two of the three patients, infection occurred, but healing eventually took place in all three.

An entirely different approach to repair of the septal perforation is Seiffert's method as described by Aubry. The septum is tented toward the largest middle turbinate until direct approximation occurs. Both the inner rim of the perforation and the adjacent area of middle turbinate must be denuded of epithelium. The nasal septum is held against the middle turbinate with a tamponade in the opposite nasal cavity until union has been made between the septum and middle turbinate. The union is then divided by resection a portion of the middle turbinate. It would seem that this method of repair is rather uncomfortable for the patient, as well as quite difficult for the surgeon.

Ismail in 1964, presented 13 cases of septal perforation repair made by utilizing a free full-thickness graft from the middle turbinate. The procedure is described as being technically easy, and the results are creditable.

Meyer has presented the possibility of the use of an acrylic or nylon obturator in the treatment for septal perforation. No reports of the results was published. It might be speculated that long-term usage of an obturator could lead to such complications as secondary infection and epistaxis.

An inferiorly based flap fashioned from the anterior lateral nasal mucous membrane was advocated by McGovern. The mucous membrane flap is reflected medially and inferiorly so that its lateral, or raw, surface can be sutured to the nasal septum surrounding the perforation. The flap must traverse the nasal cavity and be subsequently divided after the perforation has been closed. It would seem that such a pedicled flap would be difficult to create and maintain.

Goldstein (Ballenger, 1947) presented a technique using a pedicled flap of the septal mucous membrane directly behind the perforation. This flap is based just posterior to the perforation. It is rotated through the perforation and inserted between the septal cartilage and the mucous membrane on the opposite side of the septum. In preparation for the mucosal flap, the mucous membrane is removed from the inner margin of the perforation, and the septal mucous membrane is separated from the cartilage surrounding the perforation on the opposite side of the septum.

Seeley and Climo have presented a more extensive and involved approach to the problem. Both authors advocate the standard rhinoplasty incision because of the greater visibility it permits at the time of operation and because of the more extensive mucosa available for approximation. The posterosuperiorly based flap enjoys an excellent blood supply.

Another method of closure found to be most useful is that which employs a superiorly based pedicle flap on the nasal septum, to which is attached a piece of septal cartilage the size of the perforation. This procedure is in concert with thoughts of Huffman and Lierle that, "if the cartilage could be left attached to at least one side of the septal membrane as part of a compound flap," there is a higher incidence of success. The repair can be accomplished from either side of the nasal septum. A circumferential incision is made approximately 3 to 4 mm
around the edge of the perforation. The mucous membrane is carefully raised toward the perforation and elevated away from its inner margin. This maneuver affords enough epithelium so that it may be approximated with #4-0 chromic catgut on a very small, cutting, curved needle, thus closing the perforation on the contralateral side of the septum.

A superiorly based mucoperichondrial flap, which is large enough to cover the perforation and the surrounding defect, is fashioned. The inferior half of this pedicle flap is made through the cartilage, whereas the upper half is elevated in a place between the perichondrium and the cartilage. The cartilage attached to the lower half of the pedicle flap is then trimmed so that it is just the size of the septal perforation. The flap is swung anteriorly into the defect and sutured in place with #3-0 chromic catgut sutures. Keogh has described a similar procedure with apparently good results. He has chosen to cover the exposed cartilage of the pedicle flap with a free skin graft, rather than invert the nasal mucosa through the perforation.

Rubber finger-cot packs covered with aureomycin ointment are inserted into both nasal cavities. These should remain in place for at least 2 days. The patient should be instructed to avoid blowing or picking his nose during the early postoperative period. Thus far, results from this method have been quite encouraging.

Abscess of the Nasal Septum

Abscess of the nasal septum most commonly follows hematoma secondary to trauma or an operation upon the septum. It can also occur secondary to intranasal or sinus infection. It occasionally follows a furuncle of the upper lip or nose. Its most common site is the anterior cartilaginous area.

Signs and Symptoms

An abscess of the nasal septum usually develops over a period of several days. The patient complains of chills, fever, pain, and increasing unilateral or bilateral nasal obstruction. There may or may not be erythema and swelling of the external nose. On examination, either one or both sides of the nasal septum are seen to be swollen and red. There may be a loss of cartilaginous septum when the purulent discharge accumulates between the mucoperichondrium and cartilage and remains there for some time. Thus, early, adequate drainage is of great importance.

Diagnosis

Usually the diagnosis of abscess of the nasal septum is obvious when there is a history of trauma, surgical procedure, or intranasal infection. There is unilateral or bilateral nasal obstruction due to swelling of the medial wall of the nasal cavity. The fluctuation may be palpated with a cotton applicator. On occasion the development of a septal abscess may be insidious and difficult to diagnose. In such an instance, aspiration of the area with a #20-gauge hypodermic needle will be required to determine its presence. A topical anesthetic should be applied prior to the aspiration.
Treatment

Adequate drainage and antibiotic therapy constitute the treatment of choice. Cocaine solution (4%) is applied to the nasal cavity, first by spray, and then by packing with cotton strips. With a #11 or #15 surgical blade, a vertical incision is made in the area of maximum convexity. Pus is removed by aspiration and sent to the bacteriology laboratory for culture and sensitivity tests. A section of mucoperichondrium is removed with a ring punch to ensure adequate drainage. A small section of Penrose drain is then secured in place with catgut suture. When the swelling is bilateral, incision and drainage are carried out on both sides of the septum. The drain or drains remain in place until discharge has subsided (2 to 3 days). Specific antibiotic therapy is continued for at least 10 days to prevent recurrence of the abscess and loss of cartilage.

Nasal Polypectomy

Nasal polyps develop from a prolapse of overloaded edematous respiratory epithelium. The stimulus for this reaction is an irritant, which may be an allergen - bacterial or chemical. Polyps develop in areas in which tissue constructions are delicate, such as in the middle meatus and sinuses. The common sites of origin are the crest of the uncinate process, the sinus ostia, the anterior surface of the ethmoid bulla, and the mucous membrane of the sinuses, especially of the ethmoid and maxillary sinuses.

Signs and Symptoms

Nasal polyps almost invariably occur bilaterally and are quite often associated with chronic allergic or bacterial sinusitis. The symptom which brings the patient to his doctor is a gradually increasing nasal stuffiness which can terminate in complete nasal obstruction. Some patients tolerate the nasal obstruction and do not seek medical attention until they have widening of the external nose or until the polyps protrude from the nostrils. Other symptoms are those of chronic, allergic, or bacterial sinusitis.

Diagnosis

Nasal polyps are smooth, glistening, grapelike masses, yellowish or pink in color. They are rarely found in one nasal cavity only. The patient has a history of gradually increasing nasal stuffiness. As a rule, the symptoms are not seasonal and the patient has signs and symptoms of chronic sinus disease. Sinus x rays will show that the nasal cavities are partially or completely occluded. The ethmoid cell partitions are washed out, and there is usually increased density in the ethmoid labyrinth. The maxillary sinuses may show evidence of either thickened membrane or polyps. A choanal polyp may be present.

Surgical Technique of Polypectomy

The removal of nasal polyps as an office procedure is an art. An improperly conducted polypectomy is a most unpleasant experience, both for the patient and for the surgeon. If the patient seems apprehensive, slight sedation or a tranquilizer, given one half hour before the procedure, is quite helpful.
For anesthesia, the nasal cavities are packed with cotton strips impregnated with 4% cocaine solution or 2% Pontocaine solution, with added epinephrine. The packing is removed after 10 minutes. Fresh cotton strips, impregnated with the anesthetic agent, are inserted at least one additional time, until adequate anesthesia is obtained. The areas usually missed during a first attempt are in the superior and posterior nasal cavity and middle meatus.

A nasal snare with a loop, 1 inch in diameter, is used. It is adjusted to a size that can be inserted into the nasal cavity without producing pain. The operator grasps the shaft of the snare in its midsection as one would grasp a pencil. He inserts the loop in a vertical plane and then rotates it to the horizontal plane below the level of the polyp. He then slowly manipulates it over the polyps in an upward and lateral direction, toward the middle meatus, which is the usual site of polyp origin. He grasps the handle to close the wire loop while steadying the snare at its center with his free hand. The polyps are removed with forceps or metal suction tips.

This procedure is repeated until all polyps have been removed. If bleeding becomes troublesome at any time the nasal cavity is packed with cotton strips impregnated with epinephrine solution, and the operator proceeds to remove the polyps in the opposite nasal cavity. Smaller polyps are removed with Brownie, Takahashi, or ring forceps. It is best not to use traction on polyps having their origin in the superior meatus, for these may extend to the olfactory slit. Trauma in this region can produce a defect in the cribriform plate resulting in cerebral fluid leakage and its complications.

All tissue, regardless of the number or size of the polyps, or of the number of past polypectomies, should be sent to the pathology laboratory for sectioning and diagnosis. Many malignant tumors are masked by overlying nasal polyps.

Those patients who have had repeated polypectomies and in whom x rays show evidence of either chronic polypoid ethmoiditis or maxillary sinusitis, or both, should be admitted to the hospital for both polypectomy and the appropriate sinus operation, ie, intranasal ethmoidectomy or the Caldwell-Luc operation. These procedures are quite gratifying, for a significant percentage of the patients will either not have recurrence of the polyposis or will have a remission of several years' duration.

**Choanal Polyp**

The choanal polyp is a separate clinical entity. This polyp is most often unilateral and can attain enormous size. The symptom which troubles the patient is nasal obstruction. The obstruction is at first unilateral, and then, as the choanal polyp increases in size, it obstructs the entire nasopharynx. On occasion a choanal polyp may appear below the level of the uvula.

The patient should be admitted to the hospital for removal of the choanal polyp and a Caldwell-Luc operation. Simply removing the polyp is unwise, for unless the condition responsible for its origin, chronic maxillary sinusitis, is treated, a recurrence is probable.

To remove the choanal polyp, a piece of #5 snare wire, about 1 foot in length, is doubled upon itself to form a loop which is inserted into the nasopharynx by way of the nasal cavity. The ends of the snare wire are held with the surgeon's left hand. The surgeon's right
hand is inserted into the nasopharynx by way of the patient's mouth. The tip of the surgeon's finger palpates the end of the wire loop and maneuvers it up over the dome of the choanal polyp. Traction is then applied with the surgeon's left hand, and the wire loop is pulled forward in contact with the stalk of the choanal polyp in the middle meatus as it exits from the ostium of the maxillary sinus. The ends of the wire are then inserted into, and attached to, the snare apparatus. The stalk of the choanal polyp is sectioned, and the polyp is removed from the nasopharynx by way of the mouth.

A Caldwell-Luc operation is then performed, removing all polyps and diseased membrane.

Postoperative Care

Hemorrhage rarely occurs following a polypectomy. If it does it should be handled as any other epistaxis. It is best to tell the patient that in all probability the polyps will return and that it is impossible to predict when. If purulent secretion is noted at the time of polypectomy, this should be cultured and the appropriate antibiotics administered. Sinus x rays are indicated at this time. Many surgeons elect to institute short-term steroid therapy (10 days) following polypectomy in an attempt to reverse the process completely or to prolong the remission.

Intranasal Tumors

Tumors of the nasal cavity vary from small, benign lesions to massive, destructive, and invasive malignant tumors. Benign lesions tend to be smooth, firm, localized, and covered with mucous membrane. Malignant lesions are usually friable, granular, infiltrating, and susceptible to bleeding.

Signs and Symptoms

The signs and symptoms of intranasal tumors are as follows:

1. Nasal stuffiness or obstruction usually unilateral.
2. Nasal discharge, either mucoid or purulent.
3. Bleeding, scanty or profuse, usually unilateral.
4. External deformity (an expanding lesion may displace the nasal bones laterally and cause widening of the nose; masses may appear externally after eroding through bone, especially in the region of the inner canthus; destruction of bone can cause depression deformities).
5. Polypod change, which may be associated with other tumors, benign or malignant, and may mask the underlying pathologic condition in spite of repeated polypectomies and histologic examinations (thus, when suspicious of a tumor, a thorough examination (x ray, etc) is most important as well as admission to the hospital, where more adequate biopsies may be obtained with the patient under general anesthesia if necessary; any complication, such as hemorrhage, can be best managed at the hospital).
6. Pain (this may be severe when the tumor is accompanied by cellulitis or osteomyelitis).
7. Tearing (caused by invasion of the lacrimal sac, lacrimal duct, or obstruction of the nasolacrimal duct orifice by a lesion in the inferior meatus).

8. Such symptoms as pain in the teeth, exophthalmos, diplopia, paresthesia, or anesthesia of the cheek, which may indicate extension of disease to the sinuses or orbit.

**Diagnosis**

Diagnosis is established by means of anterior and posterior rhinoscopy, x-ray study (planograms), or biopsy.

**Classification**

Lesions found in the nasal cavities may be classified as follows:

<table>
<thead>
<tr>
<th>Benign Lesions</th>
<th>Malignant Lesions</th>
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<tbody>
<tr>
<td>Ectodermal</td>
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<tr>
<td>Glioma</td>
<td>Olfactory esthesioneuroblastoma</td>
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<tr>
<td>Encephalocele</td>
<td>Malignant schwannoma</td>
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<tr>
<td>Neurofibroma</td>
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<tr>
<td>Meningocele</td>
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<td>Epithelial</td>
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<tr>
<td>Dermoid cyst</td>
<td>Squamous cell carcinoma</td>
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<tr>
<td>Sebaceous cyst</td>
<td>Basal cell carcinoma</td>
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<tr>
<td>Epidermoid cyst</td>
<td>Transitional cell carcinoma</td>
</tr>
<tr>
<td>Papilloma</td>
<td>Adenocarcinoma</td>
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<tr>
<td>Inverted papilloma</td>
<td>Malignant melanoma</td>
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<tr>
<td>Mesodermal</td>
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<tr>
<td>Hemangioma</td>
<td>Ameloblastoma</td>
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<tr>
<td>Lipoma</td>
<td>Fibrosarcoma</td>
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<tr>
<td>Mixed tumors</td>
<td>Chondrosarcoma</td>
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<tr>
<td>Chondroma</td>
<td>Osteogenic sarcoma</td>
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<tr>
<td>Fibroma</td>
<td>Plasmacytoma</td>
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<tr>
<td>Osteoma</td>
<td>Lymphoblastoma</td>
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<tr>
<td>Angiofibroma</td>
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<tr>
<td>Ossifying fibroma</td>
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Certain of the benign lesions are classified as clinically malignant, either because of their location or their rapidly progressive growth and tendency to recur after removal. The inverted papilloma, mixed tumor, and chondromas are classified as such and should be treated as malignant tumors.
Principles of Treatment

Chondroma, Chondrosarcoma, Malignant Mixed Tumor, and Inverted Papilloma.
The recurrent chondroma, chondrosarcoma, and malignant mixed tumor should be treated by wide resection, for they are multiple, sessile, friable, and very susceptible to bleeding. Inverted papillomas which recur rapidly, show signs of early malignant change, or demonstrate extensive recurrence or invasion should be treated by resection followed by a full course of postoperative radiation therapy. Repeated biopsies are often misleading, for the malignant portion of the lesion may be deep. The malignant inverted papilloma (papillary squamous carcinoma) tends to metastasize to the lungs and submaxillary lymph nodes.

Ossifying Fibroma. Ossifying fibroma is considered to be a localized manifestation of fibrous dysplasia. It may appear first as an intranasal tumor and is frequently noted in childhood. It usually involves the anterior ethmoid bone, sphenoid bone, nasal bone, orbit, and base of the skull. Surgical treatment is usually unsatisfactory, incomplete, and complicated by hemorrhage.

It is now well known that the less spectacular form of fibrous dysplasia (ie, that of a solitary monostotic lesion) is not associated with any known physiologic changes and is by far the more common than the polyostotic form, the ratio being about 40:1. The monostotic form is considered by some to be an entirely different entity from the polyostotic form with non-bony manifestations.

The clinical characteristics of ossifying fibroma may be described briefly as follows:

1. The lesion has a definite female preponderance (3:1).
2. The bone lesions usually have their inception in childhood, although they may not become clinically evident until later. Occasionally, however, the onset may not be until later in life.
3. The facial bones, femur, tibia, and ribs are the bones most commonly involved.
4. The tumor usually is a slow-growing asymptomatic tumor which ceases to grow, or very markedly slows in growth rate, after adolescence.
5. There are no diagnostic laboratory findings, although, in patients with an actively growing lesion, there is an elevation of serum alkaline phosphatase (apparently derived from the abnormal elevation of this substance in the connective tissue cells of the tumor).
6. The roentgenographic picture is one of replacement of bone tissue outward, from within, toward the cortex, producing the typical "ground-glass" appearance. In the facial bones particularly, the lesions are generally sclerotic and, therefore, radiopaque.
7. The lesions, if multiple, are usually unilateral.

The prognosis is excellent. Complete removal is desirable and offers the best chance for permanent cure. Recurrence is usually the price of incomplete removal. There are, however, reports of patients who had incomplete excision without subsequent recurrence during a number of years of follow-up study. If the tumor is not symptomatic in an adult and does not appear to be growing, no therapy may be necessary. It would seem that, as with most benign tumors, individual consideration should be given to each patient in regard to the growth rate of the tumor, location of the lesion, extent of the surgical defect which would be produced by excision, and the age of the patient, since, as stated previously, growth rate...
generally slows or ceases with increasing age. The physician should be alert for signs of malignant change such as pain or sudden acceleration of growth.

The fact that malignant degeneration of fibrous dysplasia does occur is still not universally accepted. To date there have been 29 cases of malignant degeneration of fibrous dysplasia involving the nose reported. These cases all appear to be well substantiated, and several are histologically confirmed.

There is no appreciable difference in the incidence of degeneration between the monostotic and polyostotic lesions when one considers the number of lesions in the individual with the polyostotic form.

The influence of prior radiation is not clear, but radiation therapy does appear to have a predisposing propensity to malignant degeneration, as 12 of the 29 patients had received radiation therapy on an average of about 14 years prior to the onset of signs of malignant change. Conversely, it can be stated that radiation therapy is not necessarily a prerequisite for malignant degeneration, as 16 of the 29 patients had none at all. Certainly, radiation therapy should be avoided if practically possible, as it is not only implicated in the malignant degeneration of fibrous dysplasia, but is also believed to be the most significant factor in the production of bone sarcoma. Many patients with fibrous dysplasia have received radiation therapy without having malignant degeneration; therefore it is most important that consideration be given to each patient individually and all factors evaluated carefully.

Any lesions of fibrous dysplasia which suddenly exhibit an accelerated growth rate or causes severe pain must be suspected of having undergone malignant degeneration. Once the diagnosis is established, the treatment is the same as that for any bone sarcoma. Complete surgical excision of the lesion with a wide margin of uninvolved bone and soft tissue is the treatment of choice. There is a great tendency for local implantation and recurrence. Regional node dissection is not routinely advocated, as metastasis is usually by the hematogenous route. The most frequent site of metastasis is the lung. The prognosis of osteogenic sarcoma is actually not as bad as is generally believed, and occasionally patients with solitary pulmonary metastasis, in whom the entire metastatic lesion has been removed by lobectomy or pneumectomy, have experienced 5-year survivals. Radiation therapy is also frequently beneficial. It should be emphasized that osteogenic sarcoma is not a hopeless condition and that surprisingly good cure rates have been reported.

Treatment of Intranasal Tumors

Very small lesions of the anterior nasal septum or nasal vestibule, whether malignant or benign, can be resected with adequate surgical margins by way of the nostril. Electrosurgical excision is certainly of great value when removing these small lesions. For malignant lesions involving the septal mucosa, the resection should include the mucoperichondrium and cartilage. All other lesions should be approached by using the lateral rhinotomy incision.

Technique of Lateral Rhinotomy. The entire face is prepared for the operation and draped. The eyelids are closed through the tarsal plates with #5-0 or #6-0 suture material.
The patient is placed in the supine position with his head and face parallel to the floor and supported by a rubber doughnut pillow. His head is placed above the level of his chest to reduce venous pressure.

A local anesthetic agent, with epinephrine added, is infiltrated into the line of incision.

The skin incision begins, as does the external ethmoid incision, half way between the inner canthus and the nasal dorsum. A #15 blade is used for making this incision. The skin is carefully incised to the subcutaneous layers and blood vessels. The angular artery and vein are identified, clamped, and ligated. If they are inadvertently incised, bleeding can be quite troublesome. Smaller vessels can be cauterized. The incision extends down along the side of the nose rather than in the nasomaxillary skin crease until it reaches the superior aspect of the alar crease. It is then continued in the alar crease to the nostril.

The alar incision is extended through all layers and into the nasal cavity. This is continued until the nasal bone (pyriform crest) is reached. A traction suture of #00 chromic catgut, weighed with a heavy hemostat, is placed subcutaneously to provide better exposure. If the tumor is fairly anterior on the nasal septum or in the nasal cavity, additional exposure may not be necessary.

The periosteum is elevated from the nasal bone and ascending process of the maxilla with a broad square-ended perosteal elevator. Sufficient nasal bone and ascending process of the maxilla are removed for proper visualization of the nasal cavity. This exposure usually is sufficient for resection of a fairly anteriorly placed lesion or is at least adequate for evaluation and plan of attack.

Malignant lesions of the nasal septum should be handled by septectomy with as large a margin as is possible. Skimpy surgical margins or attempts to preserve the opposite mucoperichondrium or periosteum only invite recurrent disease which may be impossible to cure.

Lesions of the floor of the nasal cavity are, in essence, lesions of the palate. Malignant lesions in this area require wide excision. X rays may demonstrate evidence of bone destruction. If the malignant lesion has not invaded the bone of the hard palate, the lesion and the underlying hard palate are resected with an adequate margin. The mucosal incision can be made with the electrosurgical knife and the bone removed with the tangential Stryker saw, preserving the underlying mucosa and thus preventing a palatal defect.

If the malignant lesion has invaded bone, then all layers of the nasal floor are removed, leaving a palatal defect. The defect is blocked temporarily with gauze or cotton packing. After healing is complete, a dental prosthesis can be made.

Often it is difficult to block out a specimen from above. In these cases the procedure is combined with a palatal approach. A flap is elevated and reflected laterally and the bony hard palate removed. The anteroposterior incision is made to the contralateral side of the midline so that there will be bone under the suture line.
There are a number of operations for lesions of the lateral wall, depending upon their origin. As a rule the operation involves either removing the upper half (middle turbinate), lower half (inferior turbinate), or both.

With lower half lesions, the periosteum is elevated laterally, exposing the anterior wall of the antrum. The incision in the anterior wall of the antrum is made with a tangential Stryker saw. The incisions above and below the inferior turbinate are made with either heavy turbinate scissors or with a chisel. The specimen is transected posteriorly, with either a snare (preferably one that is insulated so that cautery can be used) or right-angle scissors.

The technique for resecting the upper half or entire lateral nasal wall is very similar, except that superiorly the lacrimal fossa and lamina papyracea must be exposed. The ethmoid bone is transected superiorly, just below the plane of the anterior and posterior ethmoid arteries. For malignant lesions - or potentially malignant lesions - the operation should also include a complete ethmoidectomy.

Benign and small malignant lesions of the superior nasal cavity can be resected with a good margin by using the lateral rhinotomy incision. It is quite often necessary to reflect the nasal bone of the involved side to the opposite side, or it may be necessary to remove this bone with the specimen. A cerebrospinal fluid leak may occur. This can be repaired with either a septal mucosal flap or a skin graft.

Lesions which invade the cribriform area or roof of the ethmoid sinus present a serious problem. Most often they are recurrent lesions (cylindroma). The best chance for cure is by means of a combined intracranial-intranasal procedure. The floor of the anterior cranial fossa is exposed by way of the frontal flap. A block including the cribriform plate and roof of the ethmoid sinus (crista galli and roof of orbit, if necessary) is outlined from above. A similar block is outlined from below by way of a lateral rhinotomy which may be extended. The two approaches are connected and the specimen removed. The defect is repaired from above with fascia lata. A split-thickness skin graft is used intranasally. A mucosal flap from the septum cannot be used, for at least the upper portion of the septum is removed with the specimen. To accomplish a complete rhinotomy the skin incision is extended superiorly across the nasal dorsum. Inferiorly, the incision does not extend into the ipsilateral nasal cavity but just below it - across the base of the columella and into the opposite nasal cavity. Lateral osteotomies are made on each side with a chisel. These are connected superiorly at the nasofrontal suture line. The nasal septum is divided with straight scissors in the same plane as the osteotomy incisions, and the nose is reflected to one side. In addition to the superior nasal cavity, the frontal, maxillary, and ethmoid sinuses are easily accessible by this approach. When closing the wound, the nasal septum should be carefully reapproximated. The skin incision is closed with #4-0 chromic silk suture and #5-0 or #6-0 dermal suture.

Intranasal portions of encephalocele which do not atrophy after intracranial section of the stalk are best approached by this exposure.

When the diagnosis of glioma is established by intranasal biopsy, a bifrontal craniotomy is performed prior to resection of the intranasal tumor. If intracranial connections are found, they are removed along with the nasal mass by the lateral rhinotomy exposure. If no connections are found, the lateral rhinotomy is performed at a later date.
For large malignant lesions which may be radiosensitive there is some value in combined preoperative x-ray therapy. If adequate surgical margins are not obtained, a full course of postoperative radiation therapy is indicated.

**Rhinophyma**

A rhinophyma is a slowly growing tumor usually involving the lower half of the nose. It may, however, involve the entire nose and part of the cheeks. Cases have also been reported in which the ear and chin are affected. The lesion is said to be an advanced stage of acne rosacea (Anderson and Dykes).

Basically the process is an inflammatory one with an associated hypertrophy of the subcutaneous and sebaceous tissues. The sebaceous glands become markedly enlarged and the dilated ducts are filled with sebum and keratotic debris. Masses of atrophic skin having large pores develop. Sebum accumulated between the masses of tissue and superficial vessels invades the surface of the rhinophyma, giving it the reddish color.

The main complaint of a patient with rhinophyma is the unsightliness of the nose. On occasion the growth may become large enough to obstruct the nostrils. A foul odor is usually present when the growth is large and ovulated. Occasionally, the rhinophyma becomes large enough to interfere with vision.

Rhinophyma is usually thought to be associated with alcoholism. Actually, there is no basis for this belief, since there is no consistent relationship. Other factors such as rich diet, gastrointestinal disorders, exposure to sunlight, and vitamin deficiency have also been indicated as etiologic possibilities without any real basis.

**Treatment**

If acne rosacea is the precursor of rhinophyma, possibly intensive care by the dermatologist would prevent its development. Once the rhinophyma has developed, surgical treatment is the only effective therapy. There are two basic methods of surgery. One consists in excision of the rhinophyma within the sebaceous gland layer so as to leave remnants of glandular epithelium which will undergo metaplasia to form the skin covering the nose.

This procedure may be conducted with either local or general anesthesia and entails sculpturing, by means of either a straight razor or a #10 surgical blade. A small electric dermatome may also be of assistance during this shaving and sculpturing procedure. Bleeding can be quite profuse and is controlled by electrocoagulating the larger vessels and packing the surface of the nose with epinephrine solution-impregnated gauze sponges. The incision around the rhinophyma should be beveled in order to eliminate the sharp demarcation between the surrounding skin and the limit of the rhinophyma. Blood loss during the procedure usually does not exceed 500 cc.

The area is dressed with petrolatum gauze or aureomycin-impregnated conforming gauze covered by a bulky dry dressing. The dressing should be changed at the end of 5 or 6 days. Re-epithelialization is usually complete by the end of 4 weeks, and the cosmetic result, although not perfect, is satisfactory to most patients.
The second method of surgical treatment for rhinophyma is total excision in the areolar layer between the disease and the supporting structures of the nose. Some form of skin grafting is, of course, necessary. Split-thickness grafts obtained from the lateral neck are said to be superior to those taken from the thigh (Anderson and Dykes). Excellent results have been reported by Macomber and by Smith through the use of full-thickness skin grafts obtained from the supraclavicular region. Matching skin grafts are taken from both supraclavicular areas for each half of the nose. The skin grafts must be very carefully sutured in place and covered by a dressing similar to that described above. Healing is usually complete at the end of one week.

Atrophic Rhinitis (Ozaena)

Atrophic rhinitis is a chronic, inflammatory disease involving the nasal mucous membrane with atrophy and fibrosis of all layers. The epithelium undergoes metaplasia to the squamous type. The cilia are destroyed, and there is a decrease or complete absence of glandular structures. The vascular supply to the mucous membrane undergoes obliterative endarteritis. The condition is referred to as "ozaena" when an odor is present.

The etiologic basis of this condition has not been established. Although bacteria are usually found associated with the disease, infection is not accepted as the primary cause. Endocrine and metabolic factors have been labeled as possible causes. Cultures usually show mixed infection. Klebsiella ozaenae, Perez bacillus, Proteus vulgaris, and coliform-group bacilli are the organisms responsible for the odor associated with this condition.

Signs and Symptoms

The signs and symptoms of atrophic rhinitis are:
1. Crusting.
2. Foul odor.
3. Complaint of nasal stuffiness, especially when crusting is extensive.
4. Wide nasal passages.
5. Bleeding mucous membrane.
7. Thick, greenish, purulent discharge.
8. Extension of the disease to the nasopharynx, pharynx, and larynx.

Medical Treatment

The nasal discharge is cultured, and specific antibiotic therapy instituted locally and systemically. The nasal cavities are irrigated with warm normal saline solution or Alkalol at least twice daily. The irrigation container is placed well above the patient's head. The nozzle is inserted into one nasal cavity. The patient is then asked to lean forward over a washbasin, breathing quietly through his mouth. The irrigating solution will enter by one nostril and leave by way of the other. Frequent visits to the rhinologist, at least during the early phase of treatment, may be necessary for removal of crusts. Such medication as vitamin A, given in high doses; nicotine acid tablets, 50 mg three times a day; and syrup of hydriotic acid, 1
teaspoonful in half a glass of water three times a day, are well worth a trial. A lubricating nasal spray or one containing iodine can be used after irrigations.

**Surgical Management**

Surgical treatment is designed to narrow the abnormally patent nasal passages. Basically, there are two techniques for implantation of substances such as bone chips from the iliac crest, deproteinated bovine chips, dolomite, and silicone. These are: implantation through a sublabial incision and implantation by way of an incision into the nasal vestibule. There have also been reports of beneficial effects following the submucosal injection of silicone or Teflon paste.

The sublabial incision is made just anterior to the canine fossa in the gingivobuccal sulcus. A small amount of pyriform crest is removed for better access to the periosteum of the lateral wall and to reduce the incidence of mucosal tearing when the implant is inserted. The periosteum is elevated lateral to the inferior turbinate as far superiorly as possible. The pocket between the periosteum and bone is then packed with the chosen implant. It is most important that there be no communication between the nasal cavity and the implant, for if a communication exists, infection and extrusion of the implant are inevitable. The sublabial incision is closed tightly without drainage. No intranasal packing is required.

Postoperatively, there will be complete nasal obstruction on the side operated upon for approximately one week, after which the swelling will gradually subside.

Implants inserted by way of incisions into the nasal vestibule can be positioned subperiosteally in the lateral wall, in the floor of the nose, or in the nasal septum. The sharp anterior margin of the pyriform crest is the guide to the periosteum of the lateral wall. Because of the pathogens that are present in the nasal cavity in association with atrophic rhinitis, infection is slightly more prone to follow implants positioned through this route than those inserted through a sublabial incision.

**Reconstructive Nasal Surgery**

For centuries man has been quite conscious of the size, shape, and color of the structure projecting anteriorly from his face. His, and the attention of his fellows, is immediately focused on the slightest defect of his nose.

Nasal defects are caused by trauma, infection, or operation for tumor removal. Surgical repair of these defects dates back many centuries and probably represents man's first attempt at reconstructive surgery. Surgeons have not only utilized the surrounding tissues for repair of nasal defects, but have also employed remote, pedicle and free autografts. In the following paragraphs are presented descriptions of those procedures best suited for repair of defects in the various anatomic sites on the nose, and, finally, the technique for total nasal reconstruction.
**Repair of Lower Lateral Nasal Defects**

On occasion, a small notchlike defect in the central lower lateral region of the nose can be repaired by means of a simple advancement procedure.

An incision, in the shape of an inverted V, approximately 0.5 cm above the small notchlike defect is made.

The surrounding area, including the ala, is extensively undermined so that the inferior margin of the incision can be retracted downward with a skin hook.

The resulting surgical defect is repaired in a linear vertical suture line.

This type of defect can also be repaired by a V-Y advancement technique. The inverted V incision is made, again undermining the surrounding area, including that of the alar margin.

The notchlike defect is erased as the defect is repaired, creating a 'Y' suture.

A large posterior, lower lateral alar defect can be repaired by using a superiorly based pedicle flap which is based posteriorly and inferiorly to the nose. A modification of this technique is that of obtaining a composite graft from the conchal region consisting of the conchal cartilage and the overlying postauricular skin. During a first-stage procedure, the conchal cartilage and skin are buried beneath the end of the flap. The cartilaginous part of the composite graft faces the subcutaneous layer. After a few weeks the flap is elevated, tailored, and sutured to the alar defect. In so doing, the postauricular skin forms the external layer of the repair.

Incision is made in the nasolabial sulcus. The flap is elevated in the subcutaneous plane and the area posterior to the defect is undermined. The flap is then rotated anteriorly, so that the posterior angle of the flap is rotated anteriorly to be attached to the anterior angle of the skin defect. Lateral vertical edge of skin is inverted and sutured horizontally to the mucous membrane margin. The medial vertical skin margin is inverted and rolled to produce the lower edge of the nasal ala. A full-thickness postauricular skin graft is obtained, fashioned and sutured in place, so that it covers the external nasal defect.

A defect of the lower lateral nose may be repaired by creating a defect above the deformity, which, in turn, is repaired by using a composite graft.

An incision is made slightly curved in the shape of an inverted 'U'. The incision is carefully carried through the subcutaneous layer to the level of the intranasal mucous membrane. A plane is established just external to the mucous membrane. Undermining is carried out in all directions, especially superiorly, to form an ellipse. The elliptic defect develops as the lateral alar margin is depressed. It is usually necessary to incise the mucous membranes intranasally, to lower the lateral alar margin, and also to make certain that the mucous membrane is present in the floor of the defect. A postauricular full-thickness graft is fashioned so that it accurately fills in the defect. Intranasal packing is inserted, and an external pressure dressing is applied.
A notchlike defect in the anterior aspect of the lower lateral nose can be repaired by rotating an inferiorly based flap in a postero-inferior direction.

Deformities of the lower lateral nose can also be repaired with composite auricular grafts. The graft is measured to be slightly larger than the nasal defect. The postauricular side of the composite graft is used for the external nasal surface. The skin-to-mucosa membrane layer is completed before the external dermal sutures are applied.

The skin on the inner margin of the defect, as well as all scar tissue, is resected. It is most important to remove this scar tissue in order to obtain an adequate blood supply for the composite graft. The posterior margin of the auricle, just inferior to the beginning of the triangular fossa, is usually the best site from which to obtain the full-thickness graft. If the graft is not too large, the auricular defect may be repaired in a straight line. For repair of larger and irregular defects, refer to otoplasty, later. The skin is sutured to the intranasal mucous membrane with #4-0 chromic catgut. It is important to make certain that the skin is in contact with the mucous membrane in all areas. The composite graft is sutured in place. A very fine polyethylene or silk suture material is used for external closure. The nasal cavity is packed lightly, but usually no external dressing is necessary.

An anterior, lower lateral, nasal alar defect is repaired by means of a two-stage procedure, using a posteriorly based full-thickness nasal pedicle flap.

A defect in the lower lateral nose above the alar region can be repaired by using an inferiorly based pedicle flap. A superiorly based nasofrontal pedicled flap can also be used to repair this defect.

A malignant infiltrative lesion in the region of the ala and lower lateral nasal wall should be widely resected. This resection includes all layers of the lateral nasal wall. Repair is made with a long nasolabial flap. The tip of this flap is folded in to form the defect in the nasal lining. The cosmetic result following this repair is quite good. A cartilage graft may be used to support the lateral alar rim.

The resected area includes a portion of the inferior nasal vestibule and anterior aspect of the floor of the nasal cavity. Bleeding should be controlled by either electrocoagulation or catgut suture. A superiorly based nasofacial flap is quite suitable for repairing this defect, which is too large to nourish a composite graft from the auricle. The length of the flap is determined by measuring the external defect and adding the required length for the intranasal lining. This flap should, of course, not be longer than twice the width of its base. Following resection of the lower lateral nasal wall, the nasal septum, anterior tip of the inferior turbinate, and floor of the nasal cavity can be seen. The flap is elevated in a plane which includes the fascia covering the muscles of facial expression. The skin is elevated superiority, laterally, and inferiorly so that the defect lateral to the nose can be closed. Subcutaneous #3-0 or #4-0 chromic catgut and dermal #5-0 polyethylene or #6-0 silk suture material are used for this repair. In order to close the defect in the floor of the nasal orifice, the mucous membrane posterior to the defect and the skin inferior to the defect are undermined sufficiently so that there is very little tension in the suture line. This defect is closed with a single layer of dermal sutures. A goodly portion of the defect lateral to the nose has been closed. This causes some elevation of the upper lip and tends to pull the lower lid downward. If it is apparent that
the ectropion will result, then it is best to perform a medial tarsorrhaphy, leaving the sutures in place until the tissues have relaxed. The defect in the floor of the nasal vestibule has been repaired. The tip of the nasofacial flap is reflected onto itself after the length necessary to cover the lower lateral nasal defect has been measured carefully. Chromic catgut suture material (#4-0) is used. The flap has been sutured in place with a single layer of dermal suture material. The extra width of the superior portion of the flap causes an outward bulge or convexity which roughly approaches a normal contour. The nasal cavity is loosely packed anteriorly with petrolatum-impregnated iodoform gauze. A dry, external pressure dressing is applied to the right eye, right face, and lateral surface of the nose. This remains in place for 48 hours. The intranasal packing can be removed after 3 or 4 days. If the cosmetic result and contour of the repair are not satisfactory, a cartilage graft can be inserted in the alar region at a later date.

**Repair of Nasal Tip Defects**

There are a number of techniques for repair of a defect of the nasal tip. A free composite postauricular skin graft is probably the most popular. For this type of repair a pattern is made from the defect to that the full-thickness graft will fit exactly into place. The graft is sutured with one layer of fine dermal suture material and covered with a pressure dressing. The postauricular composite graft technique is by far the simplest one, but on occasion the color and texture match is not good.

A second method for repair of the nasal tip involves the use of bilateral nasolabial skin flaps, which are sutured together in the midline. This technique is most satisfactory if the nasal tip defect is large and not suitable for a postauricular composite graft or a rotational flap as described below. The cosmetic result and color match with bilateral labial flaps are excellent.

In a third technique for repair of defects of the nasal tip a local advancement flap is employed. This procedure is somewhat more difficult than that utilizing the postauricular composite graft, but the color match and texture are considerably better.

**Repair of nasal tip defect - technical details**

A moderate-sized defect of the nasal tip extends to or through the lower lateral cartilages. An exact pattern of the defect is made and placed in the postauricular region from which a full-thickness skin graft, slightly larger than the pattern, is obtained.

The postauricular composite graft is carefully placed in the defect and sutured with one layer of fine dermal suture material. A pressure dressing is applied over the graft and left in place for 48 hours.

The incisions for construction of a flap consisting of skin and subcutaneous layers, overlying the nasal dorsum and root, are shown.

The flap is carefully elevated over the perichondrium of the upper and lateral cartilages and over the fascia overlying the frontalis muscle superiorly. A rather extensive underlying is required superiorly in all directions. As the flap is advanced inferiorly the sharp
tip is rounded and sutured to the opposite skin just above the level of the inner canthus. Superiorly, the defect is closed in a vertical suture line.

The repair and advancement are continued from above, downward. A small "dog ear" may occur at the base of the flap as a result of this inferior rotation. If this has not disappeared after a few months, it can be excised. A pressure dressing is applied over the entire nose and forehead and left in place for at least 24 hours. The cosmetic result following this procedure is surprisingly good.

Repair of Lateral Nasal Defects

Large lateral nasal defects are repaired by using superiorly or inferiorly based nasofacial skin flaps. As a rule, the superiorly based flap gives the best cosmetic result.

Smaller lateral nasal defects can be repaired with either the advancement technique or with a postauricular composite graft.

Repair of lateral nasal defects - technical details

Defects on the side of the nose can be repaired with a superiorly based cheek flap as outlined. The flap is based near the lateral aspect of the nose. The medial incision for the flap is in the nasolabial crease, and the tip of the flap is pointed to facilitate closure. A triangular segment of skin is removed from the tip so that it can conform with the lateral nasal defect. Laterally, rather extensive undermining is necessary.

The flap is advanced and sutured into place. The defect is closed so that the resultant scar will simulate the nasolabial sulcus. Since tension is not particularly in an inferior direction, a medial and lateral tarsorrhaphy is usually not necessary.

A smaller defect on the side of the nose can be repaired by means of an advancement technique. This operation is especially feasible if the defect can be converted to a triangular shape. An incision is made from the inferior angle of the defect to the nasolabial sulcus. A triangular piece of skin approximately the size of the defect is removed just lateral to the alar sulcus.

After the skin has been undermined rather widely over the cheek, creating a flap which can be advanced superiorly, the skin is sutured.

Repair of Nasal Root Defects

Operations for repair of defects in the root of the nose are numerous. A technique which gives an excellent cosmetic result, unless the patient has scanty eyebrows, is outlined. A small inferiorly based glabellar flap is useful for lateral defects of the nasal root.

Repair of nasal root defect - technical details

The incisions for the repair of the defect remaining after resection of a lesion at the root of the nose are indicated. The measurements of the flap to be reflected from the forehead
to the root of the nose are made according to the width and height of the defect. One incision is made in the upper margin of the eyebrow. This is a most important incision, for if the scar is even 1 mm above the eyebrow, it can become an unsightly one. The incisions above that one approach it and abut at a very sharp angle laterally.

The triangular piece of skin between the two incisions is removed, exposing the fascia over the frontalis muscle in this area. The skin is undermined superiorly in a plane over the frontalis muscle so that the flap can be pulled into the defect without too much tension. If the defect at the root of the nose is large, and the skin of the forehead is taut, it may be necessary to elevate the superior flap in a plane between the frontalis muscle and the periosteum of the frontal bone. In such cases it is usually also necessary to make a horizontal incision through the fascia underlying the frontalis muscle.

The flap and defects above the eyebrows are sutured subcutaneously with multiple, carefully placed, #4-0 chromic catgut. The skin is then repaired with #5-0 polyethylene or #6-0 silk suture material.

A small defect in the side of the root of the nose can be repaired by using a pedicled flap in the glabella region. The flap, based on one frontal artery, is oblique.

The flap has been elevated and transposed to cover the defect. Rather extensive undermining is necessary to close the defect in the glabella region.

The defect in the glabella region is repaired by subcutaneous suturing with #00 catgut and approximating the skin edges with fine dermal suture material. This flap is rotated less than 90 degrees and has an excellent blood supply.

**Subtotal Nasal Reconstruction**

Subtotal nasal reconstruction is necessary for repair of defects following resection of a large lesion of the nose. These defects are not difficult to repair, even when most of the nasal dorsum has been removed, providing sufficient bony and cartilaginous support remains.

It is usually not necessary to cover the defect with split-thickness skin graft following resection of a large lesion of the nasal dorsum, nor is this required for observation for recurrent tumor, providing careful frozen sections are made of the skin margins at the time of resection. Secondary repair after skin grafting is technically more difficult, and the cosmetic result is not very satisfactory. Large defects of the nasal dorsum which do not involve the cartilage and bone can be repaired by using the Indian type of pedicled forehead skin flap, or the island forehead flap. An alternate method for repair of a large defect of the nasal dorsum is by means of bilateral nasal facial flaps.

A thorough knowledge of the blood supply to the bases of the various pedicled skin flaps used to accomplish subtotal and total nasal reconstruction is essential.
Subtotal nasal reconstruction - technical details

Blood supply to the face is complex. Forehead flaps used for reconstructive surgery are based on the frontal branches of the superficial temporal artery, the supraorbital artery, frontal artery, or frontal branch of the angular artery. The large forehead flap used for total nasal reconstruction is based on all of these arteries.

The Island Forehead Flap

After the lesion and its margins are resected, a pattern of paper or cloth is carefully made of the defect. This pattern is transferred to the median forehead. Following the outline of the pattern an incision is carried through skin and subcutaneous layers to the fascia over the frontalis muscle. It is then carried through the frontalis muscle laterally and superiorly, but not inferiorly, exposing the periosteum over the frontal bone. A wedge of skin and subcutaneous tissue are resected superiorly and inferiorly in order to facilitate the vertical midline closure of the defect.

An incision connecting the inferior aspect of the forehead defect and the upper margin of the nasal defect facilitates exposure and dissection of the subcutaneous vascular pedicle. It also aids the rotation of the island flap, as it is reflected inferiorly to cover the nasal defect.

The flaps have been elevated in a subcutaneous plane between the nasal and forehead defects. The subcutaneous vascular pedicle is dissected posteriorly between the frontalis muscle and the frontal periosteum, in the region of the glabella.

Using a "peanut" sponge the posterior aspect of the vascular pedicle is dissected further without jeopardizing the blood supply of the island flap.

The island flap is rotated 180 degrees into position to cover the nasal defect. By exposing the area between the nasal and forehead defects, rather than tunneling, the vascular pedicle can be more neatly arranged to prevent kinking and interruption of the blood supply. The carefully repaired vertical defect that results is a small price to pay for prevention of such sequelae. Rather extensive undermining is necessary over the periosteum of the frontal bone in order to close the forehead defect. Vertical incisions through the fascia underlying the frontalis muscle on each side of the defect may be necessary in order to effect a primary closure.

The island flap has been sutured into place. The forehead defect is then repaired, and the incision between the two defects sutured. A dressing applied with moderate pressure over the dorsum of the nose and forehead, which necessitates having both eyes covered, is left in place for 24 hours.

Most of the epithelial covering of the nose has been lost, including that of the columella. The cartilaginous and bony areas of the nasal pyramid remain intact. The midline Indian forehead flap, as popularized by Dr. V. Kazanjian, probably provides the most practical method for repairing this defect. This flap is based on the medial and lateral frontal arteries.
The forehead flap is rotated 180 degrees forward and sutured to the nasal defect. If the columella is absent a superiorly based pedicled skin flap is elevated from the midline of the upper lip and sutured to the inner posterior surface of the distal end of the forehead flap. A mucous membrane flap from the midline of the inner aspect of the upper lip may also be used for this purpose. This is also based superiorly and brought out through the buttonhole incision in the base of the columella.

If the forehead donor site is 2 cm or less in width, it may be closed by extensive undermining over the periosteum. Vertical incisions as indicated through the fascia underlying the frontalis muscle are usually necessary to accomplish this closure. The portion of the defect used for construction of the columella is closed in a vertical suture line. The defects representing the portion of the forehead flap used for the nasal alar region are closed with an oblique suture line. The remainder of the defect is closed in the vertical midline, with heavy subcutaneous sutures as well as dermal sutures.

If the defect is wider than 2 cm, it is necessary to use a large rotational scalping flap on each side of the forehead. The flaps are rotated medially and sutured in the midline. The coronal incisions are made along the hairline to the level of the external auditory canals. Care should be taken to preserve the frontal branches of the superficial temporal arteries.

The final repair following advancement of bilateral scalping flaps, which are based on the frontal branches of the superficial temporal artery, is shown. If the entire nose is devoid of epithelium, then the midline flap is not practical, and the scalping flap, must be used.

**Total Nasal Reconstruction**

Total reconstruction of the nose is a complicated and technically difficult undertaking as is manifested by the numerous techniques presented in the literature. When planning this multi-procedure reconstruction the surgeon must outline a schedule for the following:

1. Lining of the nasal cavity.
2. Bony support of the nasal pyramid.
3. Outline of forehead flap for covering of nose.
4. Reconstruction of the columella and alae.
5. Repair of the forehead.
6. Touch-up procedures to accentuate alae, narrow the bridge, and thin the columella.

**Lining.** The lining for a total nasal reconstruction can be obtained from remaining mucous membrane on the lateral nasal walls, forehead flaps, or paranasal pedicled skin flaps. These various flaps have a high percentage of take, for the blood supply to these areas is more than adequate with the numerous branches of the facial, sphenopalatine, and anterior ethmoid arteries.

A medial forehead flap can be used for the lining of the nasal cavity. This will not interfere with the forehead flap to be used for the covering of the reconstructed nose. The fulcrum for the bony cantilever support can be wired in place when the median forehead is detached.
When using a combination of local and nasolabial flaps to construct the lining of the nasal cavity, it is possible to apply the bony support and nasal covering at the same operation.

**Bony Support.** The technique of constructing a cantilever shaft of rib bone, as reported by Millard, is the best means of providing support for a total nasal reconstruction because of the simplicity of the technique itself and the resulting strength and stability. The beam of rib bone extends from the glabella to the nasal tip and is supported by a fulcrum between the two maxillary bones to finally resemble the gnomon of a sun dial.

The fulcrum to support this beam is made by mortising and wiring a piece of rib bone to the maxillary bones one each side of the nasal defect. Wire holes are then drilled through the fulcrum and the maxillary bones. After the wires on each side are twisted, one end is left long so that it can be used to attach the cantilever to the fulcrum.

The cantilever strut is also constructed of rib bone. It is rounded on one end and notched at the other. Prior to its application the soft tissue is elevated in the superior aspect of the nasal defect, exposing the nasal process of the frontal bone. The frontal bone is notched inferiorly to receive the notched end of the cantilever strut. After the cantilever strut has been mortised in place, it is wired to the fulcrum.

**Covering.** A scalping forehead flap provides the best covering for a total nasal reconstruction. This flap is based on the frontal artery and the frontal branches of the superficial temporal artery. Some surgeons prefer to delay this flap for at least 2 weeks.

As a first stage, in addition to delaying the forehead flap, the portion of the flap which is to form the alae and the columella may be raised and lined with split-thickness skin graft.

The forehead flap is elevated in a plane above the periosteum of the frontal bone. It is folded on its pedicle, rotated into position, and sutured into place.

In some cases, the recipient area for the tip of the columellar portion of the forehead flap may have an inadequate blood supply. Tubing this portion of the forehead flap adds to its viability, but, on the other hand, can cause sufficient thickening of the columella so as to interfere with the airways. There are two methods which will both increase the blood supply of this columellar portion of the forehead flap and line its posterior surface. The first is that of forming a superiorly based skin flap from the upper lip. This flap is elevated subcutaneously in the midline. An alternate method is that of lining the inner aspect of the columella with a superiorly based mucous membrane flap from the midline of the inner aspect of the upper lip. This flap is reflected superiorly through a buttonhole incision in the region of the columellar base.

The periosteum of the frontal bone which is uncovered remains exposed and is covered with ointment-impregnated gauze or Telfa gauze. The portion of the defect supplying the columella for the reconstruction is closed in a horizontal, linear suture line. An external dressing of moderate pressure is applied both to the forehead and to the reconstructed nose.

The forehead flap is divided in the region of the root of the nose after 3 to 5 weeks and is reflected to its anatomic position on the forehead. That portion of the forehead...
remaining uncovered can be covered with a split-thickness skin graft or with scalp flaps rotated into this area.

Touch-up procedures may be added at a later date to narrow the nose and to form a lateral alar crease. The nose can be narrowed by incisions in the nasofacial creases. A Z-plasty can be used to form nasoalar creases in this area.

**Total nasal reconstruction - technical details**

**Lining for nasal cavities**

Flaps consisting of skin and mucous membrane are constructed on each side of the upper nasal cavity. These are turned in from each side and sutured in the midline.

A small "Indian" midline forehead flap, based on a frontal artery, is reflected inferiorly to cover the flaps.

After approximately 6 weeks, the midline flap is divided at its base and dissected from the underlying lining of the upper nasal cavity. A piece of rib bone is bridged between the two maxillary bones. This bone, which is to function as a fulcrum for the bony cantilever support of the reconstructed nose, is mortised and wired to the maxillary bones. The flap is sutured back into place to cover this bony fulcrum. The final stage of the nasal reconstruction is performed at a later date. The flap is again reflected inferiorly to form the lining of the anterior aspect of the lower nasal cavity during the operation for construction of the bony support of the nose and rotation of the forehead flap for the nasal covering.

The superior nasal cavity is lined by constructing a flap of skin and mucous membrane on each side of the nose. As small amount of skin as possible is used in this flap, in order that the lateral defect in this area will be as little as possible. Triangular-shaped nasolabial flaps are constructed on each side in the nasolabial sulcus.

Both the superior and nasolabial flaps are elevated in the subcutaneous plane. The skin lateral to the nasolabial defect is undermined sufficiently to provide for a linear enclosure.

The superior flaps have been sutured to each other in the midline. Nasolabial folds are advanced superiorly and medially and sutured to each other and to the superior flaps. The nasolabial defect is sutured in a straight line. The scar will simulate a nasolabial sulcus.

**Bony support**

A small piece of rib bone is notched at both ends. Two holes are drilled in this bone to make a fulcrum which bridges across the upper aspect of the nasal defect between the two maxillary bones. On the right, is a cantilever strut which is notched at one end and rounded at the other. The notch fits posterior to the nasal process of the frontal bone.

The fulcrum is bridged between the two maxillary bones, and then mortised and wired in place. One end of each of the two wires is left long. These ends will be used to secure the cantilever strut to the fulcrum.
The cantilever strut has been mortised to the nasal process of the frontal bone and wired to the fulcrum. The mortising of the fulcrum to the maxillary bone and of the cantilever strut to the nasal process of the frontal bone adds great strength and stability to this bony support.

A lateral view of the cantilever strut and the fulcrum. An additional wire can be placed around the fulcrum and cantilever strut if necessary.

Covering

A scalping forehead flap is used for covering in a total reconstruction. The entire forehead is utilized. The flap is based on the frontal artery and the frontal branches of the superficial temporal artery on one side. If the flap is to be delayed, the areas to form the alae and columella are lined with split-thickness skin graft. Elevation of the flap is accomplished in a plane above the peristeum of the frontal bone.

The posterior surface of the columellar portion of the forehead flap can be lined by using a superiorly based pedicled skin flap from the midline of the upper lip.

An alternate method for lining the posterior surface of the columella is that of fashioning a superiorly based mucous membrane flap from the inner aspect of the upper lip. This flap is advanced through a buttonhole incision in the region of the columellar base.

The forehead flap is folded on its pedicle, rotated to form the nasal covering, and sutured in place. The forehead defect is carefully dressed and the dressing kept in place for from 3 to 5 weeks, until the forehead flap is divided at the root of the nose. That portion of forehead which remains unsurfaced is covered with a split-thickness skin graft.