In the nasopharynx, benign tumors are less common than malignant growths. They include: (1) pseudotumors (choanal polyp), (2) cystic tumors (Thornwaldt's cyst, Rathke's pouch, mucous cyst), (3) solid tumors (juvenile angiofibroma, benign mixed tumor, fibroma, chondroma, ossifying fibroma, sarcoid neurofibroma, xanthoma, glioma, teratoma).

**Signs and Symptoms.** The signs and symptoms of benign tumors of the nasopharynx include nasal obstruction, epistaxis, anterior and posterior nasal discharge, voice change, otalgia, and hearing loss.

**Treatment of Benign Tumors of the Nasopharynx.** The choanal polyp is resected with a snare inserted by the nasal route. Following this a Caldwell-Luc operation is performed to ensure against recurrence. The technique for the Caldwell-Luc procedure is described previously.

Cystic tumors of the nasopharynx, such as Thornwaldt's cyst, Rathke's pouch, and a mucous cyst, are left undisturbed unless they present symptoms. The outstanding symptoms indicating surgery are: repeated infections, interference with the nasopharyngeal airway, and discharge. Therapy consists of marsupialization or removal of the anterior wall of the cyst. This is accomplished with an adenotome.

Solid tumors of the nasopharynx are resected by the transpalatal route unless they are completely asymptomatic and are not increasing in size. Those benign tumors which have a tendency to undergo malignant change should be resected, even when attended with no symptoms.

**Nasopharyngeal Angiofibroma**

The juvenile nasopharyngeal angiofibroma, by far the most common benign tumor of the nasopharynx, warrants special emphasis. It almost invariably occurs in adolescent males. It is highly vascular, not encapsulated, and locally invasive. It is said to undergo spontaneous regression when the patient is between the ages of 20 and 25 years. The lesion has its origins from the postero-superior nasopharyngeal vault. There are many theories as to its pathogenesis. The most logical is its derivation from embryological cartilage between the basiocciput and the body of the sphenoid. The fact that there is ossification between the sphenoid and occiput at about 25 years of age somewhat substantiates this theory.

The histopathologic appearance of the juvenile angiofibroma varies considerably. The tumor may be smooth or lobular; in consistency it varies from firm to hard; it is usually
reddish in color, with occasional areas of ulceration and exudation. Microscopically, it is seen to have a fibrous capsule, and its vascular network varies in number, size, shape, and distribution of the vessels. The vessel walls consist of a simple endothelial lining and closely resemble those of the cavernous hemangioma or erectile tissue. The variation in the number of vessels is apparent during surgical resection, epistaxis and hemorrhage being severe in some patients and minor in others. The stroma of the tumor is made up of fibrous tissue consisting of fine and coarse collagenous fibrils.

The signs and symptoms of the juvenile angiofibroma are nasal obstruction; recurrent epistaxis (often alarming); progressive deformity of the palate, face, and pharynx; otalgia and hearing loss; rhinolalia; and anosmia.

**Treatment of Juvenile Nasopharyngeal Angiofibroma.** There are numerous treatments for juvenile angiofibroma of the nasopharynx.

*Chemical Therapy.* Superficial chemical cauterization with such agents as phenol, trichloroacetic acid, and chromic acid has been used for many decades. The use of sclerosing agents such as sodium morrhuate has been reported as being successful in reducing the size of these tumors. The injection sites, however, tend to slough; this ultimately increases the bleeding surface of the tumor.

* Radiation Therapy.* External radiation is reported to decrease the amount of angiomatous tissue. Doses up to 2500 r have been employed. Maximum radiation should not be used because of its probable effect upon facial growth.

* Radium Therapy.* Reports of excellent resolution of the angiofibroma through radium therapy have appeared in the literature. Radon seeds of 1.5 mmicron are placed in the tumor, approximately 1 cm apart. With the use of radon seeds there is very little chance for interference with the facial growth centers.

*Thermal Therapy.* Diathermocoagulation of the juvenile angiofibroma has been popular but currently has fallen into disuse, except for electrocoagulation of the site of origin following resection. The feasibility of cryosurgery for resection of the juvenile angiofibroma is still doubtful. The freezing of a small or recurrent angiofibroma and allowing the tumor to remain in place and slough off may prove to be effective.

*Hormone Therapy.* Hormone therapy for juvenile angiofibroma has been in use for many years. For the most part the response is not marked and not lasting. Long-term hormone therapy in patients of this age group is decidedly detrimental. Preoperative use of stilbestrol is of great value, however, for the prevention of hemorrhage during surgery.

* Surgical Treatment.* Surgical removal of angiofibromas is still the treatment of choice. A careful hematologic work-up is indicated, for many of these patients are anemic. Whole blood or packed red blood cells are administered several days before the operation. The hematocrit value should be as near normal as is possible at the time of the operation. The patient's blood is typed and cross-matched for six units of whole blood, and the laboratory should be alerted that additional blood may be necessary.
Hormone therapy, consisting of 2.5 mg of stilbestrol given three times a day for 2 weeks prior to the operation will reduce the amount of hemorrhage during the surgical procedure. Breast tenderness and nipple enlargement will be noted after approximately 10 days of this therapy. These should be of little concern, for both disappear during the immediate postoperative period after the administration of stilbestrol has been discontinued.

Carotid arteriography contributes considerably to the diagnosis and surgical management. The carotid arteriogram is taken in the usual fashion. If the tumor extends beyond the midline, bilateral carotid arteriography is of value. The subtraction technique is helpful in outlining the vessels since these tumors are fairly well surrounded by bone. The vascular nature of the nasopharyngeal tumor is typical and fairly well establishes the diagnosis. The arteriography will also outline the extent and size of the tumor, the origin of its major arterial supply, and the site of its vascular pedicle.

Hypothermia or hypotensive techniques during the operation are of questionable value and add to the risk.

Numerous techniques for surgical resection of angiofibroma of the nasopharynx have been reported in the literature. Those which seem most practical are the transpalatal and the transantral procedure. The transpalatal approach allows for better control of hemorrhage than does the transantral approach and provides direct access to the site of origin. The transantral approach, following resection of the posterior and bony medial walls of the maxillary sinus, gives an excellent view of the posterior nasal cavity, upper nasopharynx, and pterygopalatine space. A combination of both the transpalatal and transantral approaches is used for those tumors which extend into both the nasal cavity and the pterygopalatine fossa.

**Malignant Tumors**

Malignant tumors of the nasopharynx are relatively rare (0.05% of all malignant tumors). They are more common in men than in women (3 to 1). Their incidence is increased in populations which are predominantly oriental (0.3 to 0.5% of all malignant lesions).

A histopathologic classification of malignant tumors of the nasopharynx is somewhat confusing because of the variance in nomenclature. One is as follows:

1. Transitional cell carcinoma.
2. Squamous cell carcinoma.
3. Undifferentiated carcinoma.
4. Lymphoepithelioma.
5. Lymphosarcoma.
6. Reticulum cell sarcoma.
7. Angiofibrosarcoma.

Transitional cell carcinoma is the most common. Most of the others rarely occur in the nasopharynx.
Signs and Symptoms. The signs and symptoms of carcinoma of the nasopharynx are divided into four main groups: (1) nasopharyngeal, (2) otologic, (3) ophthalmoneurologic, and (4) cervical metastatic.

The nasopharyngeal symptoms include obstruction of one or both sides of the nose, a change in speech due to hyponasality, anterior and posterior nasal discharge, and bleeding.

The otologic manifestations are due to obstruction of the eustachian tubes. A conductive hearing loss is not an uncommon sign of carcinoma of the nasopharynx. This may be associated with either serous or purulent otitis media.

The ophthalmoneurologic signs are due to the extension of the tumor from the nasopharynx into the surrounding spaces. Nearly all the cranial nerves are vulnerable when the tumor extends. The sixth cranial nerve is the one most commonly involved; diplopia due to paralysis of the lateral rectus muscle results. The third, fourth, and fifth cranial nerves are next in order for implication.

The most common site of metastatic extension of a nasopharyngeal malignant lesion is the neck and usually cervical metastasis provides the initial sign of the disease. The lymphatic drainage from the nasopharynx is by the way of the retropharyngeal glands to the upper deep cervical lymph nodes. Tumor of the cervical glands is most commonly palpated between the mastoid process and the angle of the mandible.

The signs and symptoms of malignant disease of the nasopharynx in order of their frequency are:

1. Enlarged cervical lymph nodes.
2. Blockage of the ear(s).
5. Change in speech.
6. Diplopia.

Diagnosis. The diagnosis is made by careful history-taking, physical examination, x-ray study of the nasopharynx, and exploration and biopsy. If there is clinical and radiographic evidence of carcinoma of the nasopharynx, one biopsy study showing no abnormality will not be conclusive evidence that a malignant lesion is not present. The tumor can occur submucosally and thus biopsy specimens must be obtained from a deep-down area in order to obtain a positive diagnosis.

Treatment. External radiation is the primary therapy for malignant tumors of the nasopharynx. Surgical treatment is rarely indicated except for low-grade, encapsulated malignant growth such as a malignant mixed tumor or a cylindroma, for complete extirpation of a malignant lesion of the nasopharynx is usually impossible. The midline transpalatal route is preferred if surgery is indicated. When the disease is limited to the nasopharynx, a 5-year survival rate of more than 50% can be expected. This drops to approximately 10% if there is extension of disease beyond the confines of the nasopharynx. A second course of radiation therapy is indicated for recurrent tumor at the primary site in the nasopharynx. This is
administered by either external radiation or radium in a nasopharyngeal mold. It is of interest that the longer the time elapse between the initial therapy and the recurrence, the better the prognosis after the second course of therapy.

Resection of Tumors of the Nasopharynx

The incisions for the transpalatal approach for nasopharyngeal tumors are identical to those for the repair of choanal atresia. After the horizontal incision has been made through the nasopharyngeal mucous membrane at the junction of the hard and soft palate, the nasopharynx can be inspected. Usually at least the posterior aspect of the lesion can be seen. As much of the bony hard palate at the site of the lesion is removed as is necessary for proper exposure of the tumor. Unless the tumor is large and extends anteriorly into the nasal cavity and laterally into the pterygomaxillary fossa, it can be readily resected at its site of origin. This area is tightly packed for a few minutes. Following removal of this packing, the bleeding can be gradually controlled by electrocoagulation. The insulated suction tip is valuable in accomplishing this coagulation. It is best to insert a posterior and anterior pack consisting of iodoform gauze impregnated with aureomycin ointment. Even though the bleeding appear to be controlled at the termination of the procedure, this packing should remain in place for at least 3 days.

If the tumor is large angiofibroma extending anteriorly into the nasal cavity and laterally into the pterygomaxillary fossa, none of the lesion is resected after the transpalatal exposure of its nasopharyngeal portion until a Caldwell-Luc procedure has been executed to expose the portion of the tumor that extends into the pterygomaxillary fossa and nasal cavity. Having acquired a good view of the entire lesion from two angles, by the transantral and transpalatal approaches, the tumor can be readily resected, and the site of the origin quickly packed, thus markedly reducing the amount of hemorrhage. The site of origin is treated as has been described. If necessary, the pterygomaxillary fossa and maxillary sinus can be packed in addition to the anterior and posterior nasal packing.

Choanal Atresia

Choanal atresia may be membranous or bony, unilateral or bilateral. Approximately 90% are of the bony type (Flake).

Unilateral choanal atresia often eludes diagnosis because of the absence of subjective symptoms in the neonatal period. In fact, it may be overlooked until adulthood when the patient complains of an inability to breathe through one side of his nose and of a thick, unilateral nasal discharge. The discharge may be purulent if the sinuses are chronically infected.

Complete bilateral atresia of the choanae presents as a neonatal emergency. If the infant having bilateral choanal atresia begins life crying, he is able to breathe through his mouth and thus asphyxiation is prevented. As soon as he stops crying and closes his mouth his airway is obstructed and he then becomes cyanotic. If the correct diagnosis is not made immediately and an oral airway is not inserted, the condition can be fatal. Choanal atresia probably accounts for a number of neonatal asphyxiations of undetermined causes. Thus, it is most important that the obstetrician and pediatrician be well aware of this deformity. If the
infant survives the neonatal period with the aid of an oral airway, gastric feeding tube, McGovern nipple, or, possibly, a tracheotomy, he will have the classic signs and symptoms of bilateral choanal atresia. These are: (1) constant mouth-breathing, (2) bilateral, thick nasal discharge, (3) absence of taste and smell, (4) undernourishment, and (5) defective speech. In addition there are secondary complications such as chronic sinusitis and conductive hearing loss.

Examinations for the diagnosis of unilateral or bilateral choanal atresia include (1) attempt at passing a rubber catheter or probe through the patient's nose, (2) mirror examination of the nasopharynx, (3) digital examination of the nasopharynx, and (4) x-ray examination including a lateral and base view of the nasopharynx after instillation of radiopaque material into the nasal cavity with the patient in the supine position.

Surgical Treatment of Unilateral Choanal Atresia

The surgical repair of unilateral choanal atresia is usually made when the patient is an adult. The simplest method consists in removal of the posterior portion of the nasal septum. This is accomplished by making a vertical incision in the mucous membrane of the septum, on the side of the atresia, approximately 1.5 cm anterior to the site of the atresia. The incision is best made with a right-angle knife. It is continued through the perpendicular plate of the ethmoid bone and the mucous membrane of the opposite side of the nasal septum. With ring punch forceps, the nasal septum posterior to the incision is totally removed. Following this a horizontal incision is made through the mucous membrane on the superior and inferior aspect of the atresia; the mucous membrane is then elevated and based laterally. The bony choanal atresia, with the mucous membrane on its posterior surface, is resected with Kerrison forceps. The laterally based mucous membrane flap is then reflected posteriorly and packed in place with one large finger-cot. The packing is left in place for 2 or 3 days. This intranasal procedure usually enjoys a high incidence of success, and therefore a transpalatal approach for repair of unilateral choanal atresia is rarely necessary.

Surgical Treatment of Bilateral Choanal Atresia

Some surgeons prefer to treat bilateral membranous choanal atresia by simply breaking through the obstructing membrane with an instrument such as a long, curved hemostat and inserting rubber or plastic tubing into the nasopharynx. The tubes are anchored anteriorly, just behind the columella, with a suture. Of course, this procedure is impossible for correction of a bony atresia.

Transpalatal Approach to the Nasopharynx. The transpalatal approach is the preferred method for repairing either a membranous or a bony bilateral choanal atresia, since it provides a direct route, thus permitting an exacting reconstruction. It also is used for the removal of nasopharyngeal tumors such as juvenile angiofibrous and mixed tumors.

There are a number of palatal incisions for this approach to the nasopharynx. The midline incision is the simplest, and if properly executed, is rarely complicated. The anterior palatal flap approach is also widely used.
For repair of bilateral choanal atresia the operation may be performed in the immediate neonatal period, as soon as the infant is able to withstand general anesthesia. McGovern states that the use of his specially designed nipple permits delay of the operation for one year when the operative field is doubled in size as compared with that at birth. A tracheostomy is not necessary when the McGovern procedure is employed.

**Technique of Operation.** The patient is placed in the supine position with the head extended. The surgeon sits at the head of the operating table working with the palate “in his lap”. Exposure is acquired with a McIver or Brown-Davis self-retaining retractor.

Infiltration of a local anesthetic with added epinephrine along the line of incision may be used for hemostatic purposes and to supplement the general anesthesia. The incision is made in the midline along the entire length of the hard and soft palate, to the base of the uvula. The incision over the hard palate is made down to the bone, whereas the incision in the soft palate is made only to the muscular layer. The mucosa and periosteum over the hard palate are readily elevated with right and left palatal dissectors. A plane of cleavage is established between the mucosal and muscular layers of the soft palate.

The mucosal flaps are reflected laterally by using #00 chromic catgut sutures for retraction. These sutures are either anchored around a molar tooth or weighed with heavy hemostats. The dissection proceeds with care in the region of the greater palatine foramina. It is most important that the blood supply not be disturbed after the flaps have been reflected laterally. A horizontal incision is made at the junction of the hard and soft palates. The soft palate retracts slightly in a posterior direction, exposing the nasopharynx and the choanal atresia. The posterior aspect of the hard palate extends in a postero-superior direction forming the choanal atresia. If the atresia is not bony, the reflected tissue will, of course, be mucous membrane. The dashed lines represent the area of bone to be removed. The area of bony atresia is removed with a mallet and chisel, Kerrison and Citelli forceps. When this has been accomplished, the posterior aspect of the nasal septum can be seen along with the membranous atresia. Then the incisions for relief of the obstruction and the formation of the mucous membrane flaps are made.

The mucosal flaps are elevated and tubing is inserted into the nasopharynx from the anterior nares. This tubing should be of a soft material such as Portex, polyvinyl acetate, or silicone.

At this point the operation has been completed with the exception of the initial incision. A tube has been inserted through each choana and the mucosal flaps are placed on the inferior surfaces of the tubes.

The midline palatal incision is closed with #3-0 chromic catgut, and the tubes are anchored in place by a postcolumellar suture of #4-0 silk or polyethylene.

**Postoperative Care.** No intranasal care is required other than keeping the tubes patent. This can be done with a flexible cotton-tipped applicator saturated with hydrogen peroxide solution. Oral hygiene is important during the first postoperative week to prevent contamination of the palatal incision. After a few days, the tubes are well tolerated. They should remain in place for approximately 4 weeks following operation. If the operation has
been performed after infancy, there may be some disturbance of speech and reflux of liquids into the nasal cavities for a short period following removal of the tubes. The parents can be reassured that this phenomenon is transient.

**Velopharyngeal Insufficiency**

Velopharyngeal incompetence renders a person incapable of speaking without a noticeable nasality. The emission of excessive air by way of the nasal cavity during speech results in a disturbance in quality and articulatory accuracy of the voice. Velopharyngeal closure is necessary to prevent regurgitation of liquids from the oropharynx into the nasopharynx during deglutition.

Closure of the oropharynx and the nasopharynx is accomplished by a rather complex coordinated contraction of both the palatal and pharyngeal muscles. The elevator palatine muscle contracts to pull the soft palate upward and backward. The superior constrictor muscle contracts to narrow the pharynx. The posterior wall of the pharynx is also displaced anteriorly during this contraction, especially in the region of Passavant's ridge.

**Etiology.** The most common causes for velopharyngeal insufficiency are listed below:

1. Cleft palate.
2. Paralysis of the palate.
3. Congenital shortening of the palate or excessive depth of the pharyngeal vault due to basilar skull deformities.
5. Defects in the soft palate resulting from injury or from surgical procedures, as well as scarring of the soft palate.

It is gratifying that the improved techniques for repair of cleft palate have reduced the incidence of velopharyngeal insufficiency. Hypernasality, however, persists in nearly 40% of patients who have undergone cleft palate repair.

**Diagnosis.** A thorough ear, nose, and throat examination and an audiometric evaluation are, of course, essential. The patient is also tested for level of speech maturity. His speech is recorded on tape and evaluated as to articulation and nasality. The degree of velopharyngeal insufficiency is also measured by comparing air pressure obtained when the nasal cavity is open with those obtained when the nares are closed.

Lateral x rays of the pharynx and nasopharynx are secured both while the patient is at rest and while he is speaking. The vocalization of the letters U and S is done. If the apparatus for determining pressure readings is not available, a simple comparison can be made by having the patient blow an easily inflatable balloon with and without the nares occluded. Cinefluorographic study of velopharyngeal function during speech, blowing against pressure with and without the nares occluded, and swallowing are sometimes necessary for an accurate evaluation of the velopharyngeal incompetency. The incompetency during swallowing can be most accurately evaluated by making the contrast study with the patient in the supine position.
**Treatment.** *Speech Therapy.* Speech therapy is the treatment of choice if the velopharyngeal incompetence is minimal. Surgery may not be necessary.

**Dental Prosthesis.** A dental prosthesis in the form of an obturator or an elevator is effective in some adult patients with velopharyngeal insufficiency.

**Injections.** Injections of the posterior pharyngeal wall are often adequate for restoration of normal speech when there is a minimal velopharyngeal insufficiency.

Liquid Silastic can be injected into the posterior pharyngeal wall. According to Blocksma's experience in a series of cases, its use appears quite promising. The liquid Silastic (4 to 8 cc) is injected after either a local or general anesthetic has been administered. Immediately prior to its injection, three drops of Stennous Octoate catalyst are added to 10 cc of the fluid Silastic. The material is agitated briefly and rapidly poured into a 10-cc Luer lock syringe to which is attached a #15-gauge needle with a curved end. It is injected beneath the mucosa of the posterior pharyngeal wall, just above the protuberance of the atlas. The material vulcanizes in 10 minutes into an inert rubber mass. To prevent it from migrating caudally as it vulcanizes, a tongue depressor is pressed into the posterior pharyngeal wall, just below the site of injection.

Teflon paste (Ethicon PTFE Paste) has also been used for augmentation of the posterior pharyngeal wall. The paste is placed in a 10-cc Luer lock syringe, to which is attached an #18-gauge needle with a curved end. The needle is inserted just above the prominence caused by the tubercle of the atlas, and the paste is injected until an adequate prominence can be seen. The material is placed in the submucosal layer. Caudal spread can be prevented by applying pressure, with a tongue depressor, just below the site of injection. The amount of Teflon paste necessary to effect an adequate closure is usually 5 to 10 cc. In some cases, additional amounts can be injected at a later date. The velopharyngeal space can be closed further by injecting 1 or 2 cc of Teflon paste into each side of the posterior margins of the palate.

**Implants.** In the treatment of velopharyngeal insufficiency, implants of cartilage, adipose tissue, and fascia into the posterior pharyngeal wall were for a time reported to be quite promising. However, the long-range results are unpredictable because of varying degrees of resorption. The use of solid implants of silicone rubber has been pretty much abandoned because of migration or extrusion of the implant. Possibly a soft, solid implant will be developed that will neither extrude through the mucous membrane nor migrate from its site of implantation.

**Lengthening of the Soft Palate (Palatal Pushback).** The soft palate can be lengthened by making a simple U-shaped mucosal incision or executing a V-Y Wardill pushback over the hard palate. A mucoperiosteal flap is elevated and displaced posteriorly after the nasal mucosa at the junction of the hard and soft palates has been incised.

**Posterior Pharyngeal Mucosal Flap.** The pharyngeal flap procedure is indicated for those patients with moderate to severe velopharyngeal insufficiency for whom procedures designed for augmentation of the posterior pharyngeal wall are not suited. This group
especially includes those with a congenitally short soft palate or paralysis of the soft palate, as well as those having various defects of the soft palate.

The posterior pharyngeal mucosal flap operation should not be performed on children under 7 years of age because of the frequency with which tracheotomy is required for these patients. The optimal age for patients undergoing this procedure is between 7 and 9 years.

The operation is performed with the patient under general endotracheal anesthesia and in the Rose position. The palate and pharynx are exposed with the aid of a Brown-Davis mouth gag as for a tonsillectomy. A soft palate retractor or traction sutures applied to the soft palate are used to expose the posterior epipharyngeal wall. Submucosal infiltration of a local anesthetic agent with epinephrine added, supplements the general anesthesia, reduces the amount of bleeding during the procedure, and facilitates the dissection in a plane between the constrictor muscle and the prevertebral fascia. A vertical incision is made on each side of the posterior pharyngeal wall. This should include most of the width of the wall. Dissection is carried through the mucosa, pharyngeal fascia, and constrictor muscle. The prevertebral fascia is identified, and a plane of cleavage is established with either curved or right-angled scissors. It is most important to acquire a flap of adequate length. The inferior horizontal incision connecting the two vertical incisions is thus made just at the level of the superior aspect of the epiglottis. The flap retracts superiorly as this dissection is completed. A moist gauze pack is placed against the posterior pharyngeal wall and also in the nasopharynx to control bleeding, while the soft palate is prepared to receive the inferior margin of the pedicled flap.

The uvula is grasped with atraumatic forceps, or secured with three traction sutures of #2-0 chromic catgut, and retracted anteriorly. This exposes the immediate posterior aspect of the soft palate and the palatal pharyngeal fold. A horizontal incision is made on the posterior aspect of the soft palate between bases of the palatal pharyngeal folds. The soft palate is then split horizontally, creating a bed for the inferior aspect of the posterior pharyngeal flap. Three sutures of #2-0 chromic catgut are placed at the end of the pharyngeal flap. All three are passed through the soft palate by way of the bed created, before they are tied. The end of the pharyngeal flap is then drawn onto the bed by pulling on the sutures. The knots are tied loosely so that they will not cut through mucous membrane when postoperative edema occurs.

The superiorly based posterior pharyngeal flap is far superior to the inferiorly based flap, for dissection is simpler. It is much more suitable for patients in whom the distance between the palate and the posterior pharyngeal wall is great, and in whom the flap can be sutured without tension and the posterior pharyngeal defect can be at least partially closed.

The lateral edges of the posterior pharyngeal defect are undermined, and the defect is at least partially closed by suturing the lateral margins to underlying fascia. By this technique not only is the postoperative discomfort reduced, but also the superior pharynx is narrowed, thus assisting with the velopharyngeal closure.

Complications of this operation are infrequent. Postoperative bleeding may occur. This can be avoided by careful dissection and either ligating or cauterizing bleeding vessels. If persistent bleeding does occur, it may be necessary to perform a tracheotomy and insert a pharyngeal pack. On occasion, the flap may become detached from the palate. This usually
occurs within one week after the operation, and it is, of course, essential that it be re-attached to the soft palate. If nasal respiration is inadequate following this procedure, revision of the lateral gutters must be undertaken at a later date. A late complication of this operation is shrinkage of the pharyngeal flap due to scar-tissue contraction, resulting in an insufficient velopharyngeal closure. This can often be remedied by tissue augmentation such as with the injection of Teflon paste.

**Combined Procedures.** A combination of palatal pushback and the posterior pharyngeal flap is necessary for the treatment of moderate to severe velopharyngeal insufficiency. Either a U-shaped or V-Y pushback procedure is accomplished as has been described. The result is a mucosal defect on the nasopharyngeal surface of the palate. The posterior pharyngeal flap is elevated and sutured to this defect.

**Repair of Palatal Defects.** Defects of the soft palate are a cause of velopharyngeal incompetency. They may be congenital or the result of neoplasm, surgical procedure, or trauma.

**Stenosis of the Nasopharynx**

The most common cause of nasopharyngeal stenosis is the ingestion of caustic material. Other possible causes are trauma, severe infection, and sequelae of surgical procedures. The stenosis, which involves adherence of the soft palate to the epipharyngeal wall, may be partial or complete. The patient complains of hyponasality or hypernasality. There may be a conductive hearing loss due to interference with eustachian tube function. Simple excision of the adhesions or the use of electrocautery is usually ineffective. Skin grafting and the use of stents often results in gradually recurring stenosis.

**Technique of Repair.** The operation for repair of stenosis between the oropharynx and nasopharynx is performed with the patient in the Rose position. Exposure is obtained with a Brown-Davis mouth gag with a ring attachment for an endotracheal tube.

A mucosal incision is made on the oral surface of the soft palate to fashion a mucous membrane flap which is to be reflected into the nasopharynx to cover the denuded posterior epipharyngeal wall. The incision for the construction of a buccal mucosal flap which is to cover the defect on the oral surface of the soft palate is outlined.

The mucous membrane flap has been elevated from the oral surface of the soft palate and reflected inferiorly. This leaves a denuded area on the oral surface of the soft palate.

The newly formed opening into the nasopharynx is now apparent. The mucosal flap has been reflected into the nasopharynx to cover the denuded area on the posterior epipharyngeal wall. This flap is sutured in place with #4-0 chromic catgut as the margin of the soft palate is reflected anteriorly. The mucous membrane flap has been elevated from the inside of the cheek in preparation for its rotation to cover the denuded oral surface of the soft palate.

The buccal mucosal flap has been further dissected and the palatal flap sutured in place.
The buccal mucous membrane flap has been rotated into place and sutured with #3-0 or #4-0 chromic catgut. The defect inside of the cheek is closed by first undermining the surrounding buccal mucosa and closing it in a straight line.

**Adenoidectomy and Tonsillectomy**

The decision to perform a tonsillectomy and/or adenoidectomy can be quite perplexing. With local and general nasal decongestants, biochemotherapy, and minor procedures such as myringotomy for serous otitis media, the surgeon can procrastinate and play for time. Each case must be individualized, reviewing a carefully taken history and the physical findings. At times it is difficult to overrule the persistence of the parent or referring physician who insists that the tonsils and adenoids be removed.

The following are a few positive indications which can be used as ground rules.

**Indications for Adenoidectomy:**

1. Large adenoids obstructing the eustachian tubes and causing repeated or persistent ear disease and hearing loss.
2. Sufficient obstruction from the adenoids to cause chronic sinus infection.
3. Obstruction of the nasopharynx associated with chronic mouth-breathing and "adenoidal" abnormal facial appearance.

**Indications for Tonsillectomy:**

1. Repeated episodes of acute tonsillitis.
2. Peritonsillar abscess and a history of past tonsillitis.
3. Unusual tonsil hypertrophy that interferes with swallowing and respiration. The tonsils at times can become so large that they meet in the midline.
4. Should the tonsils be removed when there is only indication for an adenoidectomy? As a rule the answer is no, for only a small percentage of these patients will require a subsequent tonsillectomy. The postoperative course following an adenoidectomy is quite benign as compared to that following a tonsillectomy.

**Technique of Surgery**

The adenoidectomy and tonsillectomy are best performed with the patient in a supine position with his head extended (Rose position). The surgeon can sit comfortably at the head of the table during the operation. Excellent exposure of the pharynx can be acquired by use of a Brown-Davis mouth gag which has a ring attachment for the endotracheal tube. The McIver mouth gag is used with the ring attachment if the incisor teeth are either very loose or absent. An endotracheal tube is used to give the anesthesiologist better control of the airway and to facilitate the administration of the anesthetic. With an endotracheal tube in place, there is very little chance for aspiration of blood or other substances.

If both adenoidectomy and tonsillectomy are to be performed, the adenoidectomy is carried out before the tonsillectomy because bleeding from the site of the adenoids is more difficult to control than that from the tonsil area. Keeping a nasopharyngeal pack in place
until the completion of the tonsillectomy is usually all that is necessary to control bleeding from this location. The nasopharynx is exposed with a soft palate retractor in order to determine the amount of adenoid tissue present. The instruments used to remove adenoid tissue include various-sized adenotomes, ring punches of varied shape, and adenoid curettes.

**Adenoidectomy.** If the patient's head is in hyperextension, it is slightly flexed so that the bodies of the cervical vertebrae and prevertebral fascia will not be too convex. An adenotome, with a width slightly less than the distance between the eustachian tube orifices, is inserted, pressed slightly in a posterior direction, and closed to remove the main mass of adenoid tissue. Before closing the blade of the adenotome, the position of the uvula must be determined so that it will not be resected. Even though the absence of a uvula usually causes no dysfunction, it can cause considerable apprehension to both the parents and the patient.

The soft palate is again retracted and the nasopharynx suctioned with a Yankauer suction tip. If any of the main mass of the adenoid in the lower nasopharynx is still present, it is removed by a second application of the large adenotome. The surgeon's index finger is inserted into the vault of the nasopharynx, palpating first one choana, the posterior margin of the nasal septum and then the opposite choana. Quite often a mass of adenoid tissue will be palpated just below the choana. A smaller adenotome with closed blade is inserted with the index finger still in place. The adenotome is guided by this finger to the mass of tissue, the blade is opened, slight posterior pressure is exerted, and the blade is closed. Multiple bites with the adenotome may be necessary to removed the mass.

With the patient's head in hyperextension, the soft palate is again retracted in order to obtain a view of the torus tubarius and eustachian tube orifices. Lymphoid tissue in these areas is removed with ring punches having both rounded and flat ends.

When the operator is satisfied that all adenoid tissue has been removed, the nasopharynx is packed with two or more dental rolls previously moistened with saline solution to which has been attached black silk suture material. The black silk suture is essential, for it is very easy to inadvertently leave a packing in the nasopharynx.

The nasopharyngeal packing remains in place until the completion of the tonsillectomy. As soon as the tonsillectomy is completed and the tonsillar fossae are packed with dental rolls, the nasopharyngeal packing is removed, and the nasopharynx inspected with the soft palate retracted. If bleeding is absent, the nasopharynx is left undisturbed. A bleeding vessel high in the nasopharynx can be detected by flexing the patient's head so that the nasopharynx is no longer dependent. The site of the bleeding will become obvious as blood trickles down the posterior pharyngeal wall. Bleeding points in the nasopharynx can be cauterized with a silver nitrate stick or electrocoagulated with an insulated suction tip. The exposure for this cautery is acquired by either retracting the soft palate or inserting a Yankauer nasopharyngoscope.

If there is any question that there may be bleeding from the nasopharynx in the immediate postoperative period, a nasal-oral string is inserted in case a nasopharyngeal pack is needed. To accomplish this a catheter is inserted into the pharynx by way of the nasal cavity. The tip of the catheter is grasped as it appears in the pharynx and a silk suture (#0)
is tied to this end. The catheter is removed from the nose and both ends of the string are tied externally. The string is cut and removed after a few hours if no bleeding has occurred.

**Tonsillectomy.** The upper medial aspect of the tonsil is grasped with an instrument such as an Allis forceps. It is pulled downward and forward, thus tenting out the mucous membrane superior to the tonsil between the anterior and posterior pillars. A small incision is made in this mucous membrane with the spade-shaped end of a tonsillectomy knife. The instrument is reversed and the right-angled end of the tonsil knife is inserted through the incision, under the mucous membrane just anterior to the posterior pillar. This mucous membrane is incised along the entire length of the posterior pillar. With the tonsil retracted slightly in a posterior direction, the right-angled knife is inserted beneath the mucous membrane immediately posterior to the anterior pillar by way of the same initial incision. This anterior incision is not performed first, for the resulting blood flow would obstruct a view of the posterior pillar.

The Allis clamp is re-applied so that it may be used to grasp the superior aspect of the tonsil. The superior pole of the tonsil is then carefully dissected in the plane between the fibrous layer of the tonsil and the underlying muscles. A tonsil dissector or curved scissors is used for this dissection. As soon as the superior pole is in clear view it is grasped by the Allis forceps so that the tonsil can be more readily retracted inferiorly. The remainder of the tonsil, with the exception of the detachment of the inferior pole, is easily dissected, by using the index finger, tonsil dissector, and curved scissors.

A wire snare is placed around the tonsil. As the snare is tightened, it is pushed slightly inferiorly as the tonsil is being retracted superiorly. In so doing the inferior pole is completely excised.

Large vessels in the tonsillar fossae should be suture ligated with #2-0 or #3-0 catgut. If there is no significant bleeding, the tonsillar fossa is packed with a moist dental roll which remains untouched for at least 3 minutes. Providing a nonexplosive anesthetic agent is being used, the insulated suction tip with electrocautery is an excellent way to obtain hemostasis in the tonsillar fossa.

With the exposure acquired by using a pillar retractor, the bleeding vessel is grasped with a hemostat. The needle is inserted in a postero-anterior direction, first below the hemostat and then above the hemostat. The hemostat is removed the suture ligature tied. This type of suture ligate (Figure "8") is much more effective and secure than a slip tie placed around the vessel.

The patient is placed in a sitting position if the tonsillectomy is to be performed with local anesthesia. A metal tongue depressor is used in place of a mouth gag. The local anesthetic solution is injected into the tonsillar side of the pillars. The tonsil is grasped and pulled medially so that the anesthetic agent can be infiltrated posterior to the tonsil. The operative procedure is identical to that described above.