Paparella III: Section 2: Disorders of the Head and Neck

Part 1: Nose and Paranasal Sinuses

Chapter 2: Nasal Fractures

G. Jan Beekhuis

Anatomy of the Nose

The external nose - a triangular pyramidlike object supported by a framework of cartilage and bone - is covered externally by skin, subcutaneous tissue, and muscle and has an inner lining of mucous membrane and glandular structures. The entire nose is innervated with nerves and has an extremely good blood supply.

The skin is relatively thin and movable over the upper bony framework but gradually becomes thicker and contains a large number of sebaceous glands over the cartilage-supported framework. The skin in this area also adheres more firmly to the underlying structures. Because of the rich blood supply, most lacerations, wounds, and incisions of the skin of the nose heal readily and rapidly; seldom are there serious infections.

The skin over the cartilage-supported framework, or the lower part of the nose, extends around the nostrils into the nares, at which point it is gradually replaced by mucous membrane. There are a number of hair follicles in this area. These follicles are prone to infections (furunculosis), which may become quite painful and irritating.

Lacerations in this area are also more problematic. Because the configuration of the nostril margin is largely determined by the underlying cartilage, lacerations in this region may lead to retraction and "notching". Therefore, it is important that when lacerations through these cartilages are repaired, the cartilages and the perichondrium be carefully approximated before closing the external skin wound.

Since the is an extremely rich blood supply beneath the skin of the nasal region, any trauma to the external nose will probably result in considerable extravasation of blood; hematoma may be present and there may be swelling over the dorsum of the nose. However, because of the looseness of the adjoining skin (eyelids and cheeks), the blood rapidly moves into these areas, frequently causing a "black eye".

As we have indicated, the upper supporting framework of the nose is rigid and bony; the lower part is cartilaginous and semimobile. The nasal septum, which provides much of the necessary support to the external nose, is bony and solid in the posterior part. The anterior septal cartilage is semimobile. The very anterior end is even more mobile.

The bony opening leading to the external nose is called the piriform aperture. The base and lower part of its lateral walls are formed from the maxillary bones. In the midline at the base there is a small protuberance, the anterior nasal spine. The upper part of the piriform aperture is formed by the inferior border of the nasal bones.

The nasal bones, the frontal process (nasal process, ascending process) of the maxillary bones, and the nasal process of the frontal bone compose the bony framework of the external nose.

These nasal bones may be described as two small, paired, oblong bones located on either side of the midline. They are attached to one another by a suture. In their upper part they are extremely thick and heavy and therefore very resistant to fracture, but in the lower part, as they approach the piriform aperture, these nasal bones become extremely thin and are very easily traumatized. For this reason, many nasal fractures involve only the lower part of the nasal bones - the thin part. Chip fractures of the lower border of the nasal bones are frequently seen.

The maxilla and the frontal bone make up the remainder of the lateral part of the nose. The maxilla grows thinner as it approaches the piriform aperture, but at its upper extremity, at which point it is attached to the frontal bone, it is quite thick. The more severe nasal fractures, especially those originating from lateral blows, usually involve the nasal process of the maxilla and also the nasal process of the frontal bone.

The upper lateral and lower lateral (alar) cartilages provide the cartilaginous support for the external nose. The paired, upper lateral cartilages are firmly attached to the inferior border of the nasal bones; they provide the framework for the middle third of the external nose. At the point that they approach the midline in their inferior part, they are usually attached to the septal cartilage. In the upper part there may be a small dehiscent area, which can be palpated in the living person. In this area, the underlying septum provides the support, and this structure may be easily palpated, especially in the individuals with very thin skin.

The lower lateral cartilages are likewise paired and are composed of a lateral crus and a medial crus. The lateral crura provide the framework of the lower third of the external nose, and the medial crura provide the support and framework for the columella. Jointly they determine the contour and shape of the external nares and nostrils.

Lacerations and injuries that penetrate the cartilages may disrupt their continuity; they must then be reapproximated. Because of their resilience, which is considerable, they will usually not be damaged by blunt injuries, but nasal fractures may result in their displacement, which is caused, in part, by their attachment to the bony structures. However, when these nasal fractures are reduced, the cartilaginous structures will usually follow suit and will not require further individual attention.

The supporting framework of the nasal septum is covered on either side by a mucous membrane that is richly endowed with blood vessels and nerves. Virtually all fractures and other

significant trauma of the nose will be accompanied by nasal bleeding.

The main supporting framework of the nose is composed of the septal (quadrilateral) cartilage, the perpendicular plate of the ethmoid, and the vomer. The crest of the maxilla, the palatine bone, and the nasal spine of the frontal bone also contribute to the framework of the septum.

The perpendicular plate of the ethmoid makes up the superoposterior part of the nasal septum. This plate of bone is extremely thin, but it becomes thicker anteriorly at the point at which it joins the septal cartilage. The posterior paper-thin portion frequently provides virtually no support. In fact, it may contain multiple dehiscences.

The quadrilaterally shaped vomer makes up the inferoposterior portion of the nasal septum. It articulates superiorly with the ethmoid and the septal cartilage.

The septal cartilage makes up the anterior part of the supporting structure of the nasal septum: posteriorly it articulates with the perpendicular plate of the ethmoid and vomer; anteriorly it has a free border at the point at which it approaches the membranous septum; inferiorly it sits in the crest of the maxilla. This union is extremely important in maintaining the proper position of the septum; nasal trauma will very easily disrupt it because the lower part of the septum and the external nose are semimobile. When the septal cartilage is dislocated at the groove in the crest of the maxilla, a large spur along the floor of the nose is the result; this is frequently seen in septal deformities. Though frequently not noticed when the septal cartilage is dislocated at the crest of the maxilla, the caudal end (free border) of the septum may also be dislocated.

Types of Fractures

The direction of the blow and intensity of its force will determine the type of nasal fracture. The nose is much more resistant to fracture from direct frontal blows than it is from lateral injuries, but fractures are, of course, caused by frontal blows as well.

Direct frontal blows may result in a fracture of the lower portion of the nasal bones, separating them from the heavier upper part or separating them at the midline and laterally so that they become "splayed out", resulting in a slightly flattened or broadened nasal bridge.

More severe trauma will cause the entire external nose to become either comminuted or disengaged from the frontal portion of the nose. These fractures are usually accompanied by fractures of the lacrimal bones and the ethmoid labyrinth. The cribriform plate and the orbital plate of the frontal bone may also be involved. In addition, there are usually injuries to the nasolacrimal system and the orbital contents. The dura may also be torn, causing leakage of cerebrospinal fluid. The medial canthal ligament may be detached, resulting in a very wide and flattened dorsum and widespread medial canthi between the eyes.

Small chip fractures, usually caused by smaller blunt objects, frequently occur along the edges of the piriform aperture, especially along the lower border of the nasal bones. Most will heal rapidly, and unless there is gross displacement, no particular reduction is required. However, these small chip fractures may cause the attachment of the upper lateral cartilages to the nasal bones to be disrupted. Provided that there is no major separation between them, they will return in time to their proper position.

The fractures caused by lateral forces are seen more commonly. Younger patients more often show evidence of fracture dislocation of the major segments; older patients often show comminution.

Moderate blows from the side, especially those caused by a small object, will result in fractures that may involve only one lateral nasal bone displacement into the nasal cavity. With more severe blows, however, the entire nasal pyramid may be moved over; on the side that has been traumatized, the nasal bones and the associated nasal processes of the maxilla may be pushed inward; on the other side they will be pushed outward.

If we liken the nasal pyramid to a tent, with the septum being the supporting tent pole, it is obvious that the septum will be moved out of its proper position by a fracture. The septum may become dislocated at the floor of the nose, moving away from the crest of the maxilla. Of course, the septum may buckle and may even tear in a horizontal or vertical direction instead. If the perpendicular plate of the ethmoid is fractured, it will carry with it the septal cartilage. Since the maximum point of deviation of the nasal septum is usually at the junction of the bony and cartilaginous septum, the caudal border of the septum will frequently be dislocated in the opposite direction. The septum, of course, plays an extremely important part in determining the eventual position of the nasal bones and the entire nasal pyramid or external nose. If the septal trauma is not diagnosed and not corrected immediately, the reduction of the nasal bones may not be adequate.

Fractures and dislocation of the septal cartilage may also occur without obvious fractures of the nasal bones. Some types have already been described. They are usually caused by blows coming from a lateral direction but directed at the lower half of the external nose. Direct frontal blows to the lower half of the nose, or trauma from below, will also lead to these septal deviations and dislocations.

If the cartilage is torn, the fragments of cartilage may telescope backward, causing a duplication and thickening of the septum. This type of injury, or the type in which the septum is markedly buckled, will result in a shortening of the nose and retraction of the columella.

Because the septum is so important in supporting the lower part of the external nose, these septal injuries will frequently result in later deformities and asymmetries of the upper lateral cartilages and the lower lateral cartilages, leading to asymmetry of the nasal tip, the columella, and the nostrils.

All nasal trauma, and particularly that associated with nasal fractures, may lead to disruption of blood vessels, skin, and mucous membrane surfaces. To prevent excessive scar tissue formation and adhesions, they should be carefully reapproximated.

Bleeding in the soft tissues will result in the formation of hematomas of the septum or the external nose, or both, especially in children. If they are not drained, they could cause the cartilaginous support of the external nose and septum to be absorbed; considerable scar tissue may form, causing severe deformities that are very difficult to correct later.

Diagnosis

Since the nose is the part of the facial skeleton that projects most, it is the area most likely to be subject to trauma. However, in spite of this, the majority of nasal fractures do not receive proper restoration based on the twofold criteria of nasal function and aesthetics.

Sometimes the patient underestimates the effects of the trauma and does not bother to seek medical attention. Frequently, however, he or she does seek medical attention by going to his or her own physician or the local hospital or clinic emergency room. There a cursory inspection reveals no fracture; even if a fracture is diagnosed, the actual degree of severity is often underestimated and nothing or little is done about correcting the problem at that time. In daily practice, every otolaryngologist encounters patients with traumatic septal deformities or external nasal deformities that warrant surgical correction by septal reconstruction or rhinoplasty, or both. Virtually all these deformities have resulted from improper medical attention at the time of initial injury.

Diagnosis is made on the basis of the history and an examination of the external nasal structures, the nasal passages, and the nasal septum. Additional special studies may also be required.

To determine the type of nasal fracture, a brief history is necessary. The surgeon should inquire as to the cause of the injury, and the direction of the blow should be noted, since this will aid in determining the type of fracture. The surgeon should always inquire about the extent of nasal hemorrhage and be aware of the possibility of leakage of cerebrospinal fluid. The patient should also be questioned about the ability to breathe through each side of the nose. If the patient reports any significant change since the initial injury or if he or she thinks there is any significant change in the shape of the nose since the injury, this too should be noted.

It is also extremely important that the surgeon learn whether the nose was perfectly straight prior to the injury. It is not uncommon to find that these patients have had previous nasal fractures and that the nose has been crooked for some time. Obviously, under these circumstances, it is impossible to achieve a perfect result unless a complete rhinoplasty is performed.

Within a few hours following the injury, there is usually considerable edema and ecchymosis. This complicates the diagnosis. Because we believe there is no harm in waiting several days before any definitive correction is made, it is not necessary to make a final judgment on the presence of a fracture if the overlying edema and ecchymosis make such a decision difficult or impossible. Under these circumstances it is important that the patient be instructed to return for another examination in about 4 to 7 days.

Observation may disclose an external deviation of the nasal bones that indicates a fracture, or the nose may be considerably flattened and broadened. Careful and gentle palpation will usually substantiate this asymmetry. The presence of crepitation is also indicative of fracture or dislocation.

In all cases, a careful evaluation of the nasal passages and the nasal septum should be done. The internal nose should be examined for the presence of mucosal tears, ecchymosis, or septal hematoma formation. Dislocation of the nasal septum along its caudal border or along the floor and deviations of the nasal septum should be particularly noted.

To perform this part of the examination adequately, proper lighting and suction should be available. With a nasal speculum and a head light or a head mirror, the inside of the nose should be examined and all blood clots and foreign particles removed. The nasal turbinates should then be shrunk with a vasoconstrictor to allow better visualization.

The surgeon should also carefully evaluate the root of the nose to see if it has been pressed below the frontal bone. The distance between the outer canthus and the inner canthus of the eye should be equal on both sides and should equal the distance between the two medial canthi. If there has been a fracture of the lacrimal bone and ethmoid labyrinth, this relationship may be altered and will require further correction, probably by open reduction. In these cases, it is also important to evaluate the patency of the nasolacrimal system and to determine the presence of fractures through the cribriform plate.

When there has been a disruption of the nasal mucous membrane, or the nasolacrimal apparatus, or both, surgical emphysema may develop when the patient tries to blow his or her nose. If present, the patient should be instructed not to blow the nose.

Radiographs of the skull or facial bones will frequently be misleading and perhaps misinterpreted by the radiologist or surgeon, or both. A grossly displaced nose may be read on x-ray film as not having a fracture. Normal suture lines may be misinterpreted as being fracture lines. Radiographs are supplementary to the clinical examination and should not unduly influence the surgeon's final decision. Special views of the nasal bones themselves are better diagnostic evidence from both a medical and a legal standpoint to the surgeon. If the patient has a clinical fracture or some asymmetry, the surgeon should not be swayed by a normal x-ray film. Conversely, if clinically the nose and septum appear to be in a perfectly normal position and the patient has noticed no change in appearance since the trauma, one should be skeptical about x-ray films indicating the presence of fracture.

Treatment

It is apparent that a careful preoperative appraisal and accurate diagnosis are important in the proper management of nasal fractures. At the time of reduction and surgery the surgeon will be guided by what he or she can see and feel in the evaluation of whether an adequate reduction has been performed.

If considerable edema and ecchymosis is present, the surgeon will be hampered in these evaluations and as a result will not be able to make a proper diagnosis and perform a properly controlled reduction. Some surgeons feel that much of this edema can be eliminated by the local infiltration of a hyaluronidase solution and by massage at the time of surgery. Thus author finds that there is no harm in waiting several days, or even up to 2 weeks, before definitive therapy is carried out. By this time most of the edema and ecchymosis will have subsided so that a more accurate appraisal and better reduction can be done. In this way the surgical procedure can be scheduled in a proper surgical environment and can be performed under more controlled circumstances.

It is true that most very simple fractures can be managed on an outpatient basis in the emergency room. Unfortunately, however, all too frequently the consulting physician is called to the emergency room at an odd hour and then attempts reduction by inserting an instrument in the nostril under the depressed nasal bone, trying to elevate it. Frequently this is done without any anesthesia, to the great discomfort of the patient. The nose promptly gushes blood, and it is obvious that the physician will have only one attempt at this type of correction. With luck, a proper reduction can be obtained, and the consulting physician and the patient will be satisfied. However, as a result of probable ecchymosis, edema, and bleeding, the surgeon cannot be sure whether he has performed a complete reduction. Often, neither the condition of the nasal septum nor the adequacy of the nasal airway is ascertained prior to or following the reduction. Even if the surgeon is not completely satisfied with the adequacy of the reduction, the patient will probably not allow a second attempt at reducing it in this fashion. For these reasons we advise that most nasal fractures be reduced in the operating room under the proper circumstances and at a properly scheduled time.

At the time of reduction, good overhead lighting and a proper head light should be used. The proper suction should be available to remove clots, hematomas, and debris. Instruments necessary for both closed reductions and open reductions should be on the surgical tray. If they are not readily available, the surgeon may hesitate to wait for them or bring the patient back for a subsequent procedure. He or she may therefore tend to be satisfied with a less than optimal result. If, however, they are immediately available, the surgeon will not hesitate to perform an open reduction, evaluate the injury, and obtain a better reduction. All instruments necessary for performing septal reconstructive surgery should also be available.

Consistently good results cannot be obtained without proper anesthesia. In children, this usually means a general anesthetic, which may be supplemented by the local infiltration of a dilute epinephrine solution to obtain better hemostasis. Because there may be bleeding from the

nose, which may run down into the pharynx and larynx, endotracheal intubation is the best technique.

In adults, local anesthesia as used in rhinoplasty and septal surgery is necessary. Adequate premedication is essential. Topical anesthesia of the nasal mucous membranes may be obtained by the use of 10 per cent cocaine with the addition of a small amount of epinephrine; this will also cause vasoconstriction, giving improved visibility. The external nose should be infiltrated with 1 per cent lidocaine (Xylocaine) with 1:100.000 epinephrine. To assure that the proper effect has been obtained, one must wait 10 to 15 minutes. If the anesthesia is inadequate and the patient has pain, he or she may become uncooperative and the surgeon cannot obtain the desired result. It is obvious that the ideal place in which all these conditions are met is in the surgical suite.

In treating nasal fractures, the desired objectives are (1) to re-establish cosmetic appearance and (2) to re-establish proper function with an adequate airway on both sides.

Surgery

Closed Reduction

The author prefers to use a graduated approach. In a unilaterally fractured nose with a depressed nasal bone and without involvement of the opposite nasal bone or the nasal septum, this is usually a satisfactory method. A blunt-ended heavy instrument is inserted under the appropriate nasal bone, and pressure is applied to elevate it back to its proper position. This is then checked by careful observation and palpation.

In bilateral fractures, with displacement of the nasal pyramid, such a closed reduction will not always be adequate. It may be attempted by inserting the blunt-ended instrument under the depressed nasal bone, elevating it, and simultaneously applying external pressure on the outwardly displaced opposite nasal bone. If the entire pyramid moves back to its proper position and the septum also comes to a proper midline position with an adequate airway on both sides, the reduction has been completed and nothing further need be done.

In our experience, however, this is seldom so easy. If the nasal reduction is less than ideal or if the septum has not returned to a proper midline position, there should be no hesitation in proceeding to the next step.

Open Reduction of the Nasal Septum

"As the septum goes, so goes the nose". If the septum has been displaced and has not been reduced, and a closed reduction of the nasal bone has been carried out, they may appear to line up in reasonably good position. However, after the splints are removed it becomes apparent that reduction will be less than ideal aesthetically or functionally.

A unilateral hemitransfixion incision should be made and the mucoperichondrium and periosteum should be elevated off one side of the nasal septum. By direct observation, the surgeon may then determine the nature of the septal injury.

If a hematoma is present, it should be evacuated. Proper postoperative pressure should be applied on both sides of the septum to prevent its recurrence. Small, loose fragments of cartilage should be removed. Larger fragments, if completely severed, may be removed but should be held in reserve, since they may have to be reinserted at the end of the procedure.

We would warn against any radical resection of septal cartilage as in the Killian submucous resection operation. Rather, the correction should be accomplished by septal reconstruction; that is, repositioning the fragments under direct observation and with minimum resection of those overriding fragments that cannot be repositioned. As much support as possible should be maintained, but a relatively straight septum with an adequate airway on both sides still must be obtained. Since all septal structures anterior to a line drawn from the nasion to the anterior nasal spine provide critically important support of the external nose, they should be maintained at all costs.

Behind this line, the perpendicular plate of the ethmoid is quite thin. Frequently it has dehiscences and does not give much support; therefore, it may be removed if this becomes necessary. The same applies to the vomer.

The most common injuries will be in the form of a septal spur along the base of the septal cartilage at the point at which it has become dislocated from the crest of the maxilla. Sometimes it can be repositioned under direct observation, but if this is not possible, a small strip of cartilage may be removed along the inferior border of the septal cartilage. After that, it may be replaced in the groove. If this is done, any caudal dislocation of the septum will be corrected and it will return to its original midline position.

The other area of major importance is the junction of the septal cartilage with the ethmoid and vomer. If this area is disrupted, the cartilage may be separated from its posterior bony attachments, with the mucous membranes and the periosteum elevated on both sides of the ethmoid and the vomer. If these bony structures have been displaced from the midline, they may be removed as far back as necessary. At this point, the surgeon must again evaluate the position of the septal cartilage. In most cases, it will now be mobile and will have returned to the proper midline position of its own accord.

If the cartilage itself has been fractured and there are overriding fragments, the surgeon may attempt to realign these. When this has been accomplished, their position can be secured by through-and-through sutures. If the fragments cannot be realigned, the small overriding strips may be resected, after which the remaining fragments are aligned and sutured. If the septal cartilage itself has buckled (usually in the vertical plane), the spring may be broken by cross-hatching or preferably by excising small strips of cartilage along the lines of maximum deviation.

The mucous membrane on the opposite side of the nasal septum should be left intact as much as possible, since it will help maintain the proper position of the various fragments.

At the termination of the septal procedure, the septum should be in a proper midline position with an adequate airway on both sides and should stay there of its own accord. One should not have to rely on packing and sutures to obtain this position, only to maintain it.

Following septal surgery, a closed reduction of the nasal pyramid as previously outlined may again be attempted. At this point in most cases it will be possible to reduce the nasal fracture, bringing it into proper alignment. However, if reduction is not yet perfect it is probably because severe comminution is present or because there is impaction of the various fragments. Under these circumstances we then proceed to other techniques.

Open Reduction of the Nasal Pyramid

Some knowledge of rhinoplasty principles and techniques is required for open reduction of the nasal pyramid. An intercartilaginous incision between the upper and lower lateral cartilages is made on both sides, the soft tissues over the dorsum are elevated to the level of the nasal bones, and by direct observation and careful palpation the surgeon may now try to obtain proper reduction. The main fragments are mobilized and brought into proper apposition.

If there is impaction along the lateral borders, a lateral osteotomy may be necessary. A small stab incision is made in the lateral part of the piriform aperture, then by means of a small osteotome, the impaction may be disengaged or an osteotomy performed to mobilize the entire external nasal pyramid. Once the nasal bones has been properly positioned, the nasal cartilages, because they are quite resilient, will usually return to their original position. If this is not the case and the cartilages have been avulsed from their attachments, they should be repositioned and their position maintained by sutures or packing.

Packing and Splinting

Following reduction, the position must be maintained by the appropriate use of internal nasal packing that acts as an internal splint. The internal packing need not be voluminous; it should not distort the external appearance of the nose. The packing should merely be enough to give some support to the dorsum of the nose. If septal surgery has been carried out, the packing should cause sufficient pressure to be applied on both sides of the septum so that hematomas will not form. The packing may be removed within several days.

The external nasal splint prevents the formation of hematoma over the nasal dorsum and at the same time reduces the amount of swelling. In addition, it helps to stabilize the fragments and prevents subluxation of the loose fragments if the patient accidentally bumps his or her nose or rolls over on it while sleeping.

The nasal splint may be of metal lined with sponge rubber or similar material. It may also be of dental compound or plaster of Paris. First a layer of tape is applied over the skin of the nose and the appropriate splint is then applied over this. In the case of metal or dental compound, the splint itself is then taped to the forehead and the cheeks. The plaster of Paris splint will adhere to the underlying adhesive tape dressing. The splint is left in position for 4 to 7 days, after which it may be removed. Following this, the patient should be instructed to avoid trauma to the nose for several weeks. He or she should also be instructed not to wear heavy framed glasses that rest on the bridge of the nose, since they may indent the loose fragments.

It should be pointed out that the surgeon should not have to rely on packing or splints to effect proper reduction. If the reduction has been adequately carried out, the structures should maintain their proper position. The purpose of the packing and splinting is only to help to maintain the position and to prevent postoperative edema, bleeding, or further injury.

The Severely Comminuted Nose

In patients in whom there is severe comminution and fragmentation of the nasal bones, together with loss of support, the previously outlined steps should be followed so that as good a reduction as possible can be obtained. However, one should be cognizant of the danger in doing an open reduction. There may be so many bony fragments, many without proper soft tissue attachments, that it is impossible to reposition them, and one may even lose many of these fragments.

If there has been too much loss of support, additional procedures may be necessary to maintain the proper position. In these patients, a small lead plate may be placed over some adhesive tape, sponge rubber, or gauze on either side of the external nasal pyramid. A through-and-through suture of nonabsorbable material is passed through the plates, the skin of the external nose between the comminuted fragments, through the septum, and through the opposite side, and back again. The suture is then tied to help maintain the support. The internal nose is also packed under the nasal bones to help maintain the proper position. In these cases, the packing and the splints should be left in for a longer time, that is, until sufficient fibrosis has occurred to help to stabilize the position.

Again it should be pointed out that many of these severely comminuted nasal fractures are associated with fractures of the lacrimal bone and ethmoid labyrinth. If there has been disruption of the medial canthal ligaments, the orbital function, or the nasolacrimal apparatus, an open reduction with an external skin incision will be necessary to expose the areas of fracture and permit reduction under direct observation.

Compound Nasal Fractures

If there have been extensive lacerations of the mucous membranes, they should be carefully reapproximated whenever possible. If this is not possible, they should be reposition and the nose packed to maintain this position until they are properly healed. In this way adhesions

between the turbinates and septum may be prevented, as may much scarring with web formation and stenosis of the internal nose.

When there have been external lacerations of the skin, the nasal bones should first be reduced and then the external lacerations meticulously closed in layers. The subcutaneous layers should be carefully closed with multiple fine interrupted catgut sutures. The skin edges should be approximated, without tension, using very fine nonabsorbable sutures. In all cases, the layers of closure should be from within outward. When cartilage is involved, the fragments should be properly aligned and then sutured with catgut sutures. Careful and meticulous attention to the closure of these soft tissue wounds will nearly always result in good healing and minimal scarring, obviating the necessity for secondary procedures.

Nasal Trauma in Children

Adults and children present different kinds of problems to the practitioner because in children the entire external nose is quite small, as are the nasal bones. Nasal fractures are accompanied by hematoma, ecchymosis, and edema. These conditions, together with the size of the child's nose, make diagnosis more difficult than in the adult. X-ray films can be particularly misleading in children. Minor displacement of the nasal bones will not result in gross deflections of the external nasal pyramid and are therefore frequently missed. Childhood is the time when the nose is particularly subject to bumps and falls that are the cause of many nasal and septal deformities that appear clinically later in life. Nasal fractures in children may also lead to a disturbance of the growth centers, which would cause improper development of the external nose.

With appropriate and proper reduction, evacuation of hematomas, and so forth, much can be done to prevent these problems. The general principles of reduction can be applied. However, in addition, we must take into consideration factors such as future growth of the nose. Any radical procedure that might interfere with the growth centers of the nasal bone or septum is certainly contraindicated. However, it is essential that reasonably good reduction be obtained. All hematomas of the septum and the dorsum of the nose must always be evacuated. Septal dislocation and deviations that interfere with the nasal airway should definitely be corrected, using as conservative a technique as possible. If this is not done, the child will have nasal obstruction (and possibly even stenosis), and these factors in themselves will lead to considerable latent morbidity and even maldevelopment of the nose.

If the nasal bones are not reduced and are left in a depressed state because of lack of support, the nose will not develop properly. This will result in a marked saddle deformity, columellar retraction, and an extremely short nose with a flat, flaccid, broadened nasal tip.

In later life, this condition is extremely difficult to correct. It must, therefore, be re-emphasized that the best time to correct nasal fractures is as soon as possible following the initial injury.

Late Management

If following the initial injury the patient delays the visit to the physician for several weeks, the appropriate reduction becomes much more difficult and an open reduction with rhinoplasty will usually be necessary. This is also true when the patient has many associated injuries that take precedence over the reduction of the nasal fracture. In most of these patients, a complete rhinoplasty will be indicated at a later date.

Follow-up

It is important that the patient be followed by the surgeon for at least a year after surgery. Only in this way can the surgeon adequately evaluate the effects of the reduction, thereby improving his or her own technique and also diagnosing late complications and deformities that may require secondary correction.

Many of these late complications are caused by the formation of scar tissue and may not appear until several months after the initial trauma. For example, if there has been too much loss of septal support, ensuing scar tissue will give rise to a columellar retraction, with a saddling of the middle third of the dorsum of the nose.

A very thick nasal septum may also result from septal hematoma, with the formation of considerable subperichondrial fibrosis. This is extremely difficult to correct, as there are no good planes of dissection. After the mucous membrane has been elevated and preserved, the fibrosis and the fragments of cartilage within it may have to be resected. If there is insufficient septal support, some of the fragments may then be reinserted and sutured into position.

Another common complication is the formation of adhesions between the septum and the nasal turbinates. This frequently happens when considerable packing has been used; if left in too long it results in two raw surfaces becoming approximated. If the synechia is quite small, it may be cut from the septum and the turbinate, removing the intervening piece. The nose should then be kept shrunk down for several days until healed. Larger synechiae must be sectioned and a piece of silicone sheeting or similar material placed between the opposing raw surfaces until such time as the mucous membrane has healed. The silicone sheeting is sutured through and through to the septum to fix it with proper position.

In the patient in whom there has been considerable damage to the mucous membrane of the internal nose, webbing and stenosis may result. If these webs are relatively small, they can be corrected by Z-plasty. With more extensive webs, the scar tissue must be completely resected and the denuded area skin-grafted with a split-thickness skin graft. The skin graft is maintained in position by packing and sutures until complete epithelialization has occurred.