Nasal Problems in Children

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INTRODUCTION

Nasal problems in children are very common. For this reason, we are concerned with recognizing abnormal conditions that affect their health and welfare. We are interested not so much in the variety of nasal deformities as in the possible effect of anatomic variations on the supply of oxygen to the body.

The long-term variations from early injuries must not be confused with congenital anomalies and deformities. In a congenital defect, an area fails to develop. Prenatal and postnatal deformities are essentially variations from normal. Deformities of the nose and especially the septum commonly occur during labor, particularly in the infants of primiparas.

In addition to the basic appearance seen in congenital and birth deformities, there is the effect on the airway. This applies particularly to an area where so much diagnostic confusion exists. A minimal narrowing in the upper respiratory pathway may make it difficult for the child to obtain an adequate supply of oxygen. A difference of a millimeter in the lumen of the nasal airway may create nasal respiratory insufficiency. There are many anatomic variations of the so-called normal nose. When these variations affect proper function, however, they must be considered to be pathologic.

For this reason, airway problems are frequently overlooked. Deformities of the nose may be passed over in the routine checkup. The pediatrician, family physician, and rhinologist should carefully examine children with disturbed nasal function.

The examining physician is at a distinct disadvantage because no objective means for evaluation of nasal function is available. Although attempts at diagnosis of airway problems have been going on for more than 75 years, no equipment has
been developed to accurately measure airway problems comparable with that for the diagnosis and treatment of eye, ear, or cardiac pathology.

CONGENITAL DEFORMITIES AND ANOMALIES

Either intrauterine or extrauterine disease may cause defective development of the nose. Genetic defects are usually apparent at birth. These anomalies must not be confused with deformities caused by injury to the infant's nose, which may not be recognized until later in life. The sixth, seventh, and eighth weeks of embryologic development are the most important, for it is then that maternal disease and medications affect the olfactory and nasal structures.

Extrauterine diseases — such as measles, chickenpox, and syphilis — are known to cause defective development. Maternal medications may also affect the developing fetus. Hypoplastic nasal structures have been traced to the warfarin sodium derivatives that were prescribed for mothers with mitral valve protheses. Nasal obstruction has also been reported in newborn children of mothers who were given reserpine. In these cases the cartilaginous nasal capsule, beginning about the third fetal month, gradually becomes bone.*

A second critical time for the developing nasal apparatus is the fourth fetal month, when differentiation of the nostrils and midline fusion of all facial structures begin to take place. All nasal structures arise from embryonic cartilage; in the septum and external nose, the mature bone is derived from its perichondrium. During this period of maturation, such deformities as a bifid nose, congenital absence of nasal bones, atresia of the choanae, dermoid cysts of the nose, and cleft palate may occur.

Bifid nose is a serious congenital deformity in which the embryonic lateral processes fail to fuse properly in the midline. It may occur alone or with cleft lip and palate.

In congenital absence of nasal bones, the cephalic portion of the cartilage capsule is not replaced by bony tissue; the broad, flat nasal pyramid that results shows no evidence of bones on x-ray examination.

Choanal atresia may be unilateral or bilateral. It results from failure of the nasal buccal membranes to rupture and from the retention of the posterior portion of the primitive nasal floor.

Dermoid cysts of the nose occur along the nasal dorsum between the lower margin of the nasal bones and the lobule. They represent areas of embryonal epithelium that survive along the fusion line to the intranasal fissure. The sinus tract that is present connects the cyst with the skin surface. The sinus tract present in the midline of the dorsum of the nose may have hair extruding or caseous material that can be expressed from the opening of this tract.

Cleft palate and cleft lip may be complete or incomplete, unilateral or bilateral. These congenital deformities result from partial or complete failure of the lateral halves of the secondary palate to fuse with the septum. This deformity is unsightly and creates a psychologic problem for the parents, and it requires surgical procedures to correct the deformity and

* In the fetus, the cartilaginous nasal capsule and ethmoidal region are the last portions of the chondrocranium to be cartilaginous. The vomer, membranous in origin, develops as a bilateral lamina at the posterior part of the septum. The general resorption of the cartilage occurring between these two laminae may persist normally until about eight years of age. In one out of five infants tested by Gray, there was a hard bony obstruction in the nose at birth that was still present 14 days later. Studies by Beck indicate a partial to severe obstruction in such infants, caused by a structure consisting of an intimate connection of cartilage with bone.
aid the patient psychologically as well as physically.

**NASAL TRAUMA IN THE PRENATAL AND NATAL PERIOD — BIRTH INJURIES**

Injuries to the nose often occur in the prenatal, natal, and early-childhood periods. Dislocations of the septum from trauma may influence both the quantitative and the qualitative development of the maxillary, premaxillary, and nasal elements. Facial asymmetries and sagittal and dental malalignments and malocclusions may result. Occasionally a child is born with a fixed deformity from pressure against the pelvis or from an injury to the mother during pregnancy, as described by Kirchner. Of normally delivered white babies, about 7 per cent have marked deformities of the nose and 30 to 50 per cent have temporary flattening.

Investigators have found that at birth the distance from the tip of the nose to the occiput is 2-3 mm. greater than that from the chin to the occiput. This temporary flattening results from dislocation of the septum at birth. Also, the size of the pelvis as related to the size of the infant's head determines the degree of compression and the resultant flattening. In most cases, these dislocations return to normal within a few days. In others, it is necessary to grasp the septum with the thumb and index finger and rock them into place. Occasionally, there is enough bleeding into the septum or the dislocation is severe enough to cause permanent deformity that will require correction at a later date.

Gray found that pressure on the external nose during birth was not commonly associated with bony obstruction. The deformity found at birth is usually due to bending of the cartilage without dislocation from the maxillary crest, which corrects itself in a few days.

The frequency of extrauterine nasal injuries is very high. As the most exposed and prominent feature of the face, the nose naturally bears the brunt of many injuries — injuries often so trivial that neither the mother nor the patient remembers when they occurred. External nasal deformities in adults may result from a combination of apparently minor childhood injuries and growth factors.

**CARE OF ACUTE INJURIES**

The incidence of nasal trauma in children is extremely high. An apparently mild injury may result in a poorly functioning nose. A minor injury in a child may become a major deformity in an adult. These injuries are difficult to diagnose, but they do influence growth patterns that affect function as the child matures.

Although a number of authors discuss bony involvement, few mention involvement of the cartilaginous portions of the nose and the influence that injuries to them have on the development of deformities. Salinger, in reporting his findings on nasal injuries during childhood, said that children are more prone to cartilaginous than to bony injuries because the size of the nasal bones is small at this age. These early injuries have a marked effect on the development of the nose.

Aside from injuries received at the time of birth, many other seemingly minor injuries to the nose of a child may leave their mark later in life. In 1926, Carter discussed his 18 years' experience in correcting nasal deformities resulting from the slight injuries to the nose that occur so frequently in childhood. The fall against the side of the crib, the bump re-
ceived when a child falls against a chair, the contusion occurring when he tumbles out of his walker — all these seemingly trivial happenings will determine the configuration of the adult nose.

As the child grows older, he continues to be exposed to many so-called minor bumps. There may be no epistaxis, edema, or ecchymosis. Often, neither the child nor his parents remember the incidents, tending to think only in terms of a very hard blow with an immediately visible deformity.

The pediatrician or general practitioner can be helpful or harmful to children with nasal injuries. He is usually the first physician whom the parents consult as to the seriousness of an injury and whether or not it requires or justifies immediate special treatment. When the physician understands the implications of possible sequelae, he will be able to advise the patient on the importance of early care.

The general surgeon should also be cognizant of nasal injuries, for he is usually the one who sees these patients in the hospital emergency room or in the accident ward. In many cases, nasal injury is associated with other body injuries. At this time, attention is drawn to more severe injuries, and the nasal problem is thus neglected.

Rhinologists must realize the potential sequelae of an injury to the nose. Some physicians are justified in saying they find that cases referred to a rhinologist may receive only a tampon in the nose and a strip of adhesive tape over the nasal dorsum, with no consideration given to the cosmetic and functional complications that might arise later. Education of the rhinologist about these problems is very important.

Immediate care is essential and should consist of a careful examination by inspection and palpation of the external nose and inspection of the internal nose and by palpation.

Figure 1. Abrasions and contusions in a five-year-old five days after injury. They are a probable source of future deformity.

Figure 2. Hematoma and ecchymosis five days after injury. They will influence future development.
with a cotton-tipped metal applicator. Although x-ray examination should be done, it may be misleading and cannot be relied on. Examination and immediate treatment are often delayed until the x-ray report is available. This may be negative in about 50 per cent of injuries with nasal fracture. One must know the anatomy to understand that the nasal pyramid in children is largely cartilaginous and does not show up on x-ray findings. The cartilaginous vault and the septum may be torn loose from the chondro-osseous joint, with definite clinical findings. Acute nasal injuries in children are often overlooked, treated haphazardly, or ignored until complications occur.

An acute injury demands immediate evaluation and treatment. Care should be taken to prevent the collection of blood in the tissues, and this causes at least as much damage as the actual injury. Plates of scar tissue replace the absorbed blood. The contracting scar tissue results in twisting, angulation, and bending that produce the deformity so evident in later life. Figure 3 shows a severe injury requiring immediate care.

The so-called mild type of injury produces minimal edema and ecchymosis. There are no hematomas of the nasal septum of dorsum and no mucosal tears or bleeding. It is, however, quite common to see nasal deformities in adults who, during childhood, suffered an apparently mild injury that was followed by progressive deformity and increasing difficulty in breathing. Contusions may amount to nothing more than a mild abrasion on the dorsum or tip. Because there is no bleeding from the nose or ecchymosis of the eyes, such injuries are ignored when they occur. One frequently sees children with abrasions and contusions of the forehead, nose, lip, and chin. There are no fractures, no hematoma, and no dislocation of the septal cartilage. Although the injury is mild, it is probably sufficient to affect normal development. Parents should be made aware of the probable influence of injury and its relation to future growth factors.

A greenstick fracture of the septal cartilage is another example of mild injury. Nasal bones are small and short, and the cartilaginous structures are more prominent in children. On taking a blow, the septal cartilage will angulate but will spring back to its original position. In some cases, however, even minimal extravasation of blood and serum into this fracture line will cause healing to continue.

Figure 3. Ten-year-old girl one hour after injury with a baseball bat. Immediate closed reduction was performed with rhinoplastic dressing. The 10-year result was good.
proceed by fibrous union; the result will be progressive angulation and deviation that may account for some anterior septal deviations and nostril obstructions.

In some cases, there is no history of a particular injury but there is sharp angulation of the septum. At some time, a direct blow upward against the cartilaginous part of the nose resulted in a greenstick fracture, extravasation of blood, and stimulation of cartilaginous overgrowth in the septal envelope. The outcome is obstruction of one nostril or both.

Lacerations indicate a more severe injury and, therefore, command attention. In some cases, however, the underlying structures are ignored when the lacerations are sutured. If this happens, some of the following complications may result:

**Septal hematoma.** A laceration, fracture, or dislocation of the septal cartilage may cause a dissecting hematoma to develop beneath the septal flap. The septal mucosa appears blue. Often, it is so swollen that it occludes both nostrils. Early recognition, incision, and drainage by suction are essential. Frequently, it is necessary to use general anesthesia in order to drain the area properly and to apply firm and snug internal and external splints. Improper care and lack of sufficient
packing may result in re-formation or progression of the hematoma, as well as secondary infection and development of a septal abscess. **Septal abscess.** Infection with abscess formation due to septal hematoma is a very destructive condition. The cartilaginous septum becomes necrotic. The upper lateral cartilage, which is part of the septum, also becomes involved in this destructive process.

An excellent example is a case of a child who was thrown from a tricycle onto her nose. No treatment was given. Two weeks after the injury, there was onset of redness and swelling (Figure 4A). The temperature was 103 degrees. Under local anesthesia, the abscess was incised and drained. Bank septal cartilage was then implanted. Antibiotics were given. The result was good and the deformity minimal.

After healing, heavy scar tissue replaces the necrotic cartilage. This pulls the nasal structures downward and causes a characteristic deformity. There is a sharp depression just below the lower margin of the nasal bones, flattening or saddling of the cartilaginous vault, widening of the base of the lobule, and marked retraction of the columella. Such sequelae should be prevented by early incision and drainage so that it will not be necessary to resort to corrective surgery to restore the function and contour of the nose. Figure 4B shows a one-year follow-up of the septal abscess illustrated in Figure 4A.

**Hematoma of the nasal dorsum.** This injury is less common than hematoma of the septum; unless one is aware of such a condition, the diagnosis is missed. Hematoma of the nasal dorsum usually results from a direct blow. Tearing of the upper lateral cartilage from the nasal bones is followed by a dissecting hematoma. Pressure necrosis of the nasal bones and cartilage on the injured side of the nose results. Figure 5 indicates a severe baseball injury with a C-shaped dorsum and a hematoma of the left nasal dorsum.

A hematoma of the dorsum is less likely to become infected than one of the septum; it can be just as serious as a septal abscess, however, for it will destroy the nasal bone and upper lateral cartilage. Early diag-

![Figure 5. A: Hematoma of the left nasal dorsum as the result of a baseball injury. B and C. C-shaped deformity of the nasal pyramid.](image)
nosis, incision, drainage, and application of a pressure dressing will prevent posttraumatic nasal deformity (Figure 6).

One must suspect the condition and rely on clinical findings rather than x-ray diagnosis to evaluate a dorsal hematoma; one should evacuate early and apply a pressure dressing before destruction of the structures can occur.

Each case is treated according to the findings. Examination is made with the patient under local or general anesthesia. Lacerations are meticulously sutured, and hematomas or abscesses are incised and drained. Fractures of the septum and pyramid are managed either by closed or by open reductions. Firm internal and external splints are very important aids to healing, for they not only prevent blood from collecting in the tissues but also immobilize them.

The slightly injured nose presents the most difficult problem of all. When the diagnosis is obvious, the course of treatment is obvious. The child with merely a bloody nose from a fall presents a diagnostic problem. Keep in mind that embryologically the nose is a cartilaginous structure, and the term "fractured nose" is misleading. For this reason, x-rays should not be relied on, as the nasal bones in a child are short and make-up only a small portion. An x-ray report of "no fractures visualized" will give a false sense of security.

BASIC CONSIDERATIONS REGARDING AIRWAY PROBLEMS IN CHILDREN

The nose is a complex organ, and its function is closely related to the functions of all other organs in the body through a complex reflex system. It is part of the respiratory mechanism that plays an important part in the normal function of breathing. During the past 80 years, much work has been done in many countries on the study of the relationship between nasal obstructive disease and lung function, but this work has been unrecognized and neglected. Ogura et al. have reported that there is a correlation between nasal obstruction and pulmonary function when measured through the nose. Also, with increased nasal obstruction, functional compliance decreases whether measured through the mouth or the nose. With correction of the nasal obstruction, there reportedly was an increase in functional compliance. Comroe, in his studies of respiratory physiology, noted that "a decrease in lung compliance and upper-airway obstruction will diminish alveolar oxygen concentration." The upper-airway obstruction in these cases is hypertrophy of the tonsils and adenoids. Thus, in the presence of nasal obstruction, there is a constant struggle to obtain the oxygen necessary for everyday activity. Breathing through the nose as compared with breathing through the mouth was thoroughly studied by Butler in 1959. He noted that the expansion of the lungs was markedly increased by nose breathing in all subjects studied. Breathing through the mouth is a chief symptom of nasal obstruction in children. Findings associated with these obstructions are frequent colds, nasal and postnasal discharge, recurrent sore throats, sinus infections, nervousness, irritability, insomnia, and lack of concentration as evidenced by poor scholastic standing.

For these reasons, the children need correction of their obstructive problems. Rather than a "wait and see" attitude, reconstruction of the septum or removal of large tonsils
Figure 6. Deformity of the nasal pyramid in a four-year-old patient secondary to hematoma of the nasal dorsum. A: Two months after injury, there is severe depression of the bony pyramid. B: The nasal pyramid five years later after two operations. There was normal development at age nine.

and adenoids is indicated. In the correction of an obstructive septal deformity, the surgeon must do as little as possible and as much as necessary to restore adequate nasal and pulmonary respiration. Dislocation of the caudal end of the septum from the V groove of the maxillary spine, premaxilla, and vomer always persists as an irreversible deformity. This requires the maxilla-premaxilla approach of Cottle, which is usually adequate to correct all anterior septal deformities.

EFFECT OF EARLY INJURY ON FACIAL ASYMMETRY AND MALOCCLUSION

Following a childhood injury to the nose, abnormal growth of the nose, dentition, and facial features may result secondarily to obstruction to breathing. For a clearer understanding of the clinical problems presented, one must review some of the pertinent facts of disturbed physiology of nasal respiration and its effect on mastication, deglutition, and dental occlusion.

Normal breathing represents a balance of muscular forces. In respiration, the mouth is closed and the mandible is in the resting position. The tongue on the inside molds and spreads the dentoalveolar arches, while the lips and cheeks counteract the force like the hoops on the staves of a barrel. However, obstructed nasal breathing represents an imbalance of muscular forces, which in the developmental stage adversely influences potential growth. Mis-directed muscular action of the tongue, lips, and cheeks in mouth

continued
breathing results in faulty molding of the dentoalveolar arches. The palate is high, vaulted, and narrow, with malocclusion and asymmetry of the lower face. A typical picture shows the mouth open, the mandible pulled downward and backward by the suprahyoid group of muscles, and the tongue down in the pharynx, interfering with mastication, deglutition, and speech. The upper lip is short and everted and fails to cover the incisor teeth. This is why discoloration of the exposed parts of the incisor teeth occurs.

It is concluded that obstructed nasal breathing from enlarged tonsils and adenoids or deviated septum results in inability to use the tongue to mold the dentoalveolar arches. This results in a high-arched palate that may extend into the nasal cavity and further increase the septal deformity. The patient is unable to breathe and to chew at the same time. So, while the mandible develops normally; the muscles of mastication pull down externally, preventing normal maxillary development. This increases the tendency of the palate to narrow and increases the cross-bite. Figure 7 indicates a severe dental problem secondary to a septal deformity and collapse of the upper lateral cartilage, resulting in malocclusion, malalignment, and facial asymmetry in a patient aged 10.

Figure 8 shows a similar problem in an 18-year-old following long-term deformity caused by injury in childhood.

**CHRONIC SINUSITIS IN CHILDREN**

Chronic sinusitis in young children may be overlooked, as the child is unable to describe his specific symptoms, such as a sense of fullness, discomfort, or pain over the affected sinus. It is the secondary signs and symptoms that lead the physician to

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suspect and diagnose this entity. The most common of these are chronic nasal discharge and chronic nasal obstruction, the result of swollen turbinate mucosa and mucopurulent discharge. In the nasopharynx, irritation of the eustachian tube may induce serous or suppurrative otitis media. Irritated pharyngeal mucosa produces chronic sore throat with enlargement and tenderness of the cervical glands. General symptoms of irritability and fatigue do occur, with a low-grade fever often diagnosed as “fever of unknown origin.” Purulent material in the inferior meatus may lead to chronic dacryocystitis.

When allergy is a factor, the seasonal signs and symptoms of rhinorrhea, sneezing, and itchy eyes and throat may be present. Allergic rhinitis occurs in 20 per cent of the U.S. population. It is probably the second most common background of acute and chronic sinusitis. The sinusitis may result from a prolonged perennial allergy to dust, household pets, feathers, food, etc. Seasonal allergies are caused by grass, trees, and ragweed. A careful examination is essential; it may show irritation, cracking, and crusting with thick mucopus in the nose. It is difficult to identify infected sinuses by spot suction. Frequently, both nostrils are filled with this heavy purulent material. Much of this material may be seen in the nasal- and oropharynx. Pressure over the frontal or maxillary regions rarely elicits any tenderness.

Demonstrable x-ray findings are not sufficient to diagnose active sinusitis. Inactive disease or allergic changes may alter the x-ray appearance, but the state of activity of the infection is usually in keeping with the intranasal findings.

Sinusitis of dental origin may be found in older children; apical disease of the premolar or molar teeth may extend through the alveolar bone.

**SUMMARY**

Nasal problems in children are very common. The factors that affect the embryologic development have been discussed. Injuries that occur in prenatal, natal, and postnatal periods affect normal development. Prompt treatment of minor injuries is necessary to prevent airway problems later. The “wait and see” attitude toward nasal deformity is ill advised. X-ray findings are not conclusive, as the nasal pyramid in a child is largely cartilaginous. Obstructive nasal breathing can result in facial asymmetry, malocclusion, and cardiopulmonary problems. Allergy and sinusitis are frequently causes of obstruction.

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