Influence of the Nasal Septum on Maxillonasal Growth in Patients with Congenital Labiomaxillary Cleft

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An interpretation of the role of the nasal septum on maxillonasal growth in patients with congenital labiomaxillary clefts is presented. Salient features of the anatomic pathology and resultant dysfunction of the premaxillary-maxillary suture and the position and orientation of the nasolabial muscles relative to the nasal septum are discussed for unilateral and bilateral deformities. The nasal septum plays an important direct role in growth of the premaxilla and an indirect role in growth of the maxilla.

Studies of facial growth in patients with congenital cleft lip and palate have not led to conclusive results. A great deal of attention has been directed at the role of the cartilaginous nasal septum in facial growth, but results from a wide variety of experiments on laboratory animals have not clarified the subject (Delaire and Precious, 1985). The purpose of this paper is to present our interpretation, based on clinical observations, of the influence of the nasal septum on maxillonasal growth in patients with congenital labiomaxillary clefts.

PREMAXILLARY-MAXILLARY SUTURE

Congenital labiomaxillary clefts result from the absence of fusion or incomplete fusion of the maxillary and medial nasal processes. Normally, this fusion takes place on the thirty-sixth or thirty-seventh day of gestation at a time when all the elements of the cartilaginous mesethmoid are already well differentiated (Couly, 1980).

By contrast, the first points of ossification in the premaxilla and the maxilla appear only toward the fortieth day (or the end of the sixth week), at a time when the ectomesenchyme of the facial processes forms a continuous mass without a trace of zones of fusion. Premaxillary and maxillary points can thus join and unite outside the dental lamina, which is already individuated, at a point that will later correspond to the canine region. This fusion is normally complete at the end of the eighth week. From this date forward, the osseous plate thus formed develops in all directions: behind (posterior maxilla), in front (premaxilla), above (the ascending process and pyramidal process), and within. In this last direction the osseous elements pass between the dental processes, and ossification progresses just to the midline at the median interincisive suture, which is extended behind the nasoplatine foramen to the median palatine suture. In the plane that joins the two canine regions, another suture forms, classically called in man, the incisivocanine suture, but which would better be called the premaxillary-maxillary suture as it is in animals. It is the equivalent of this suture that separates the two skeletal parts (premaxilla and maxilla) in animals. The fact that in man it is filled in at the end of the eighth embryonic week, outside the dental lamina, does not alter its physiologic importance. Indeed, it is a seam of rupture and distention and a place of future adaptive osseous growth (Fig. 1).

Let us note that the incisivocanine suture is not an embryonic vestige of the fusion of facial processes that takes place before bone formation has started. It results from a completely different process, namely active osteogenesis on both sides of a plane that will later become this suture. In any case, it is evident that if a congenital labiomaxillary cleft exists, that is to say if...
there is no union of the internal nasal and maxillary processes, the points of ossification of the premaxilla and the maxilla cannot approach each other and ultimately unite. The congenital maxillary cleft therefore occupies a territory where the incisivocanine suture would normally have formed, but it is not at all the same thing. This point should be well understood.

NASOLABIAL MUSCLES

The superficial muscles of the face, which arise from the second branchial arch, migrate laterally and medially between the epiblast and the subjacent ectomesenchyme and normally reach the midline in the week that follows the fusion of the facial processes.

In the case of a complete labiomaxillary cleft, the muscles of the nasal floor and upper lip obviously cannot bridge the congenital cleft nor unite with the muscles of the opposite side. The muscular architecture of the region is therefore seriously disturbed, which in turn has a profound effect on the underlying skeleton.

Normally the anterior muscles of the face form three rings, schematically arranged as follows: (1) a superior nasolabial ring formed on each side by the transverse nasal muscle, the levator labii superioris, and the levator labii superioris alaeque nasi muscles; (2) a middle labial ring formed on each side by the orbicularis oris muscles of the upper and lower lip; and (3) a lower labiomental ring formed by the depressor anguli oris, depressor labii, and mentalis muscles (Fig. 2).

The transverse nasal muscle is the most important physiological element in the upper ring (Delaire, 1974). It extends from the anterior border of the nasal bone to the incisive crest (on both sides of the nasal septum) and to the adjacent septal perichondrium. Thus, it surrounds the nasal orifice and possesses two important functions: (1) nostril constriction, and (2) support of its corresponding half of the upper lip, particularly the external head of the orbicularis oris of the upper lip, which itself supports the labial commissure. The internal fibers of the oblique head of the orbicularis oris normally extend into the columella and are connected to the anterior
border of the nasal septum, its perichondrium (in front of the anterior nasal spine), and the skin covering the columella.

The nasal septum, on both sides of which are normally inserted symmetrical muscles, remains in the midline. Similarly, the superior median interincisive suture is situated along the length of the septum and is united to it by the septopremaxillary ligament and the median cellular ligament of the upper lip (Delaire et al., 1977) (Figs. 3 and 4).

**FIGURE 2** Schematic representation of the three rings of the anterior muscles of the face. Tr = transverse nasal muscle; RS = levator labii superioris alaeque nasi; Rp = levator labii superioris; Can = caninus muscle; Pt Zyg = zygomaticus minor; Gd Zyg = zygomaticus major; Bu = Buccinator; Or sup chef ext = external head of obicularis oris superioris; Or sup chef int = internal head of obicularis oris superioris; Or inf = obicularis oris inferioris; Tri = depressor anguli oris; Car = depressor labii inferioris; Hou = mentalis muscle.

**UNILATERAL DEFORMITIES**

In the case of the total unilateral labiomaxillary cleft, the muscles on the cleft side remain outside the defect and, even if they are correctly formed, cannot function normally. Deprived of the nasal septum as a point of anchorage, the muscles sag abnormally down and back, thus putting pressure on the minor segment, tending to push it back and at the same time tending to bring its anterior part closer to the midline. Growth of the minor segment appears reduced as a probable consequence of the absence of stimulation to nasolabial muscles and the lateral expansion of the septopremaxillary ligament of Latham (Delaire and Chateau, 1977).

On the nonleft side, the muscles that normally insert on the nasal septum pull on it and drag it along with the nonleft nostril (Fig. 5). The same occurs to a lesser degree with the anterior portion of the major segment, the median interincisive suture, and the two incisive processes.

The premaxilla is less developed than normal, particularly on the cleft side, because of the discontinuity of the peristeum and the attendant absence of normal muscular periosteal stimulation. On the nonleft side, the premaxilla is also underdeveloped by an amount equal to the degree to which the median interincisive suture is bent to this side (Fig. 6).

The alar cartilage of the cleft side sags and is pulled down and flattened by divergent muscular traction corresponding to the degree of its missing normal support. The median septum is

**FIGURE 3** (A) Septopremaxillary ligament, (B) anterior nasal spine, and (C) median cellular ligament of the upper lip.
FIGURE 4 Functioning upper lip demonstrates muscular anchorage at the location of the inferior part of the nasal septum and the anterior nasal spine. Note the appearance of the median cellulous ligament of the upper lip.

FIGURE 5 Schematic representation of muscular imbalance in the unilateral labimaxillary cleft.

FIGURE 6 (A) Occlusal radiograph of 6-month-old infant just prior to performance of primary functional cheilorhinoplasty. Note deviation of the median interincisive suture to the healthy side. Note also the reduction in size of the premaxilla on the healthy side by an amount equal to the degree of deviation of the median interincisive suture. (B) Occlusal radiograph of same patient at 16 months of age (8 months after primary functional cheilorhinoplasty) demonstrating an improved orientation of the interincisive suture relative to the true midline. Good symmetrical premaxillary and anterior maxillary growth can now take place.
deviated to the noncleft side, and the pyriform aperture on the cleft side is pushed back and malformed. The cartilaginous deformations can therefore be considerable, but, except for rare cases, there is no hypoplasia of the cartilage. Indeed, there is frequently no cutaneous hypoplasia, and if the skin appears insufficient, particularly at the base of the columella, it is because it has not been distended (Fig. 7).

The nasal bones, influenced by the cartilaginous septum, are also deviated to the noncleft side. On the cleft side, the sagging of the nasal capsule induces a retrusion of the ipsilateral nasal bone, which is often associated with an internal rotation of the anterior part of the ascending portion of the maxilla. This usually results in lateral displacement of the medial canthus, giving the appearance of unilateral hypertelorism, which is in fact telecanthus.

All of these anomalies are exaggerated in the case of the complete velopalatine cleft associated with a total unilateral labiomaxillary cleft. Inversely, they are reduced in severity by the presence of a subnasal cutaneous bridge (Simonart's band). In incomplete labiomaxillary clefts, as one would expect, the anomalies are correspondingly less severe.

**BILATERAL DEFORMITIES**

In the case of total bilateral labiomaxillary clefts with cleft palate, the condition of the lateral fragments is identical to that seen in unilateral cleft. The anterior medial disposition of these fragments is often particularly accentuated by the posterior spreading of the two tuberosities.

The median fragment has the shape of a bar, extending the vomerine beam forward from which it is separated by the premaxillary-vomerine suture. This bar represents all of the premaxilla whose lateral parts have not developed because of the congenital bilateral clefts and the total absence of stimulation of the median intercisivesuture. At its anterior part are seated the dental processes that extend beyond the anterior nasal spine, itself situated further forward than normal.

The premaxilla is longer than normal (Fig. 8), which, according to Pruzansky (1971), results from excessive stimulation of the premaxillary-vomerine suture which in turn is caused by absence of a muscular sling of the upper lip. We agree that it is this suture that is responsible for the excessive elongation of the premaxilla, but the absence of the muscular sling is not sufficient to explain the excessive sutural growth. To achieve excessive sutural growth there must be active sutural distention in which the pressure of the lower lip, situated behind the developing upper alveolar process probably plays a principal role. One cannot exclude, however, the active role of the cartilaginous septum whose growth is in a downward and forward direction and is not controlled by the nasolabial muscles.

In the case of total bilateral labiomaxillary clefts without cleft palate, this excessive growth of the median process is even more evident (Fig. 9). It extends markedly in front of the anterior portion of the maxilla, which ostensibly is well positioned, anteroposteriorly, in relation to the mandible. The vertical level of the palate is also apparently normal. The study of these observations has led some authors (Bergland and Borchgrevinck, 1974) to think that the nasal septum is not an influencing factor on pre- and postnatal growth of the human maxillary complex.
We are diametrically opposed to this opinion because, in these cases, the anterior part of the maxilla usually presents with a very severe transverse deficiency such that the deciduous canine tooth buds are almost in contact. Also, even if the anterior position of the maxillary canines coincide with that of the mandibular canines, this does not signify that the maxilla is normally developed. In fact, Burston (1958) has noted that “the bilateral condition is characterized by two retroplaced and small maxillae, very frequently associated with a certain degree of micrognathia of the mandible.” Above all, it seems to us erroneous to say that “except for the severely protruded premaxilla the facial appearance of the infant is fairly normal” (Bergland and Borchgrevink, 1974). Also, we do not think that findings of normal facial configuration following good repair of the muscular sling and orthodontic treatment constitutes “the decisive evidence that the nasal septum cannot play an influential role either in pre- or in postnatal midfacial growth in man” (Bergland and Borchgrevink, 1974).

We have observed similar cases, and we believe that good primary surgery reconstituted not only the facial esthetics but also the function of the nasal-septal complex, the nasolabial muscles, and the median cellulous septum of the upper lip (Delaire et al, 1977), thus restoring function to the ensemble, which in turn favors good anterior maxillary and premaxillary growth (Delaire and Chateau, 1977; Delaire, 1983).

CONCLUSIONS

In the unoperated child, the absence of the nasolabial muscles to the nasal septum and the resultant deformities demonstrate an important action of the septal cartilage, not only directly on the premaxilla but also indirectly on the growth of the maxilla. The dramatic examples reported by Victor Veau (1938) in the “Surgical Monstrosities” section of his book clearly show the necessity of avoiding injury to the nasal septum and the importance of using its dynamic force in aiding growth of the nasomaxillary complex.

To achieve good growth it is essential at the time of the primary functional cheilorhinoplasty to obtain a good, symmetrical fixation of the nasolabial muscles of the cleft side(s) to the anteroinferior part of the septal cartilage in front and on both sides of the anterior nasal spine (Delaire, 1978, 1983). The reconstitution of equilibrium and muscular function of both the floor and sill of the nose and the upper lip encourages premaxillary-maxillary growth (Figs. 10 and 11), which is less likely to occur with
FIGURE 10  Total bilateral labiomaxillary cleft without cleft palate (same patient as Fig. 9) (A) at 6 months of age before primary functional cheilorhinoplasty and (B) 10 years after.

FIGURE 11  Total unilateral labiomaxillopalatine cleft (A) at 5 months of age before primary functional cheilorhinoplasty and (B) at 8 years of age, in repose and (C) during function. Note absence of marked nasolabial asymmetry and particularly the midline position of the nasal septum.
other techniques, even though they may be esthetically excellent. Good symmetry of muscular insertions on the septum also prevents deviation of the anterior border of the nasal septum into the noncleft nostril and the resultant corresponding deviation of the nasal spine, the median interincisive suture, the maxillary dentalveolar midline, and the anterior border of the nose. It also contributes to limit the severity of vomerine deviations of the cleft side, as does the avoidance of the use of vomerine mucosa in the closure of velopalatine clefts (Delaire and Precious, 1985).

Thus, these clinical observations suggest that the nasal septum both directly influences growth of the premaxilla and indirectly influences growth of the maxilla and in so doing plays an important, active role in facial growth of patients with congenital labiomaxillary clefts.

References

BERGLAND O, BORCHGREVIN K. The role of the nasal septum in mid-facial growth in man elucidated by the maxil-