Maxillary Growth Following Total Septal Resection in Correction of Orbital Hypertelorism

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A rapid survey of eight cases with orbital hypertelorism did not reveal any evident change in maxillary displacement during facial growth following resection of nasal septum and medial displacement of orbital cavities. Accurate analysis of four cases according to the Ricketts long-term growth forecast showed a reduction of growth in the region of anterior nasal spine and only in the posteroanterior direction. This is not necessarily due to the absence of nasal septum. These patients have such severe deformities and the surgical procedure is so extensive that many factors can be responsible for deficient premaxillary growth. Further studies are needed, particularly in patients who, since 1975, have had the same operative method, but without septal resection, to know whether this more conservative procedure has changed the posteroanterior growth of the premaxilla. However, a nasal bone graft has a good prognosis, even when performed in children.

The role of the cartilaginous nasal septum in the growth of the human midface is still unknown (Delaire J, Chateau JP, 1977; Latham RA, 1970). Is the cartilage a purely passive support of the nose, and the septal growth secondary to the primary growth of the nasal cavity, as claimed by Moss (1968) and his colleagues? Is the septal cartilage a primary growth center responsible for the development of the midface as assumed in Scott's hypothesis (1953)? To answer these questions of the active or passive role of the nasal septal cartilage, experimental studies have been done in various animals, at first in nonprimates (rat, rabbit, and pig) and then, more recently, in primate subjects.

The results of these experiments were not conclusive. They vary according to the selected animal, the age at operation, and the landmarks used. Thus, in 1981, Siegel and Sadler stated that total submucosal resection of the septal cartilage in chimpanzees, the most humanlike animal, does not alter the anterior facial growth. However, it must be emphasized that in this paper evaluation of growth was based on the position of the dental arch related to the cranial base. Anyway, assimilation of results from animal studies to human growth is disputable.

The radical surgical treatment of some types of severe craniofacial malformations has given us the opportunity to study the facial growth after total septal resection in children (Fig. 1A through 1H).

In 1963, Tessier operated on his first case of orbital hypertelorism through an intracranial approach. The orbits were displaced medially, together with the lateral walls of the nose, notably reducing the volume of the nasal cavity. Therefore, in the early 1970s, surgical treatment included resection of the whole nasal septum (bone, cartilage, and mucosa on both sides) in order to maintain a sufficient space for nasal breathing (Fig. 2). The procedure was replaced...
FIGURE 1  A to D, Orbital hypertelorbitism due to median craniofacial cleft before and after the procedure described in Figure 2.
FIGURE 1 (Continued)  E and F, Preoperative and postoperative frontal tomograms. The nasal septum was partially absent in this patient. It was completely removed at the time of operation. G and H, Lateral cephalometric radiograph before and after treatment. Good appearance of the nasal graft 15 months after the operation.

after 1974 by resection of the inferior and medial turbinates. In some cases, a large iliac or costal bone graft was wedged into the frontal bone to give support to the nasal root.

It was interesting to study the maxillary development of these young patients operated on by Tessier, patients who had a septal resection and now have reached adulthood, because this is a true human experiment. The preliminary report of this study is presented here.

In 1980, in Paris, Fruzansky presented his own study of similar cases before and after they were operated on by Tessier in Chicago. He concluded that there was no forward growth of the maxilla postoperatively.

MATERIALS AND METHODS

The sample consisted of 8 cases (4 males and 4 females) ranging in age from 4 to 11 years at the time of operation. All of them presented orbital hypertelorism of various etiologies.

The total resection of the nasal septum could be assumed from the operative record and the postoperative frontal tomogram. Cephalometric radiographs taken at a distance of 4 meters both before and after the operation were available for these eight patients.

Lateral cephalograms were traced and evaluated according to the Ricketts standards. Both “static” and “dynamic” analyses, including long-
FIGURE 2 Tessier's procedure for correction of orbital hypertelorbitism.
term growth forecasting and superimpositions, were used.

Radiographs taken from 1½ to 9 years postoperatively allowed for long-term results evaluation. No statistical analysis of data was attempted, since the sample was too small.

Growth changes in the upper face were studied in two ways: (1) superimpositions of pre- and postoperative tracings on the cranial base line to observe displacement of facial structures, and (2) superimpositions of postoperative and long-term growth forecast tracings to show the influence of the surgical procedure (septal resection) on maxillary development in four of the cases.

In our cephalometric study, all points and planes of reference belong to the Ricketts analysis, some of which are defined as follows:

(a) The Francfort horizontal plane is traced from true porion to orbitale.
(b) The pterygoid vertical plane (PTV) is erected perpendicular to Francfort plane from the pterygoid root (PR), selected at the most posterior outline of the pterygopalatine fossa. The intersection with Francfort plane is called Francfort center (CF).
(c) The pterygoid point (Pt) is located on the lower border of foramen rotundum and is identified at the upward and backward curve of the pterygopalatine outline.
(d) The centroid of the ramus (Xi) is derived by bisecting the vertical height and horizontal depth of the ramus.
(e) The facial axis, constructed by connecting cephalometric gnathion with cranial Point Pt, serves as a central reference axis in the face and determines the overall type of pattern of the patient. On average, its orientation does not change with time (change=0 degrees ±1.5 degrees each 5 years).

The dynamic analysis implies:

(a) Long-term growth forecasting (the technique is not described here—Ricketts RM, 1972 and Langlade M, 1981.)
(b) Method of superimposition: reference planes and registration points.
(c) A frame of reference to establish the precise degree to which treatment or normal growth are responsible for the changes observed. Ricketts has proposed a polar view of growth based on a center located on the basion-nasion plane registered at the point cranial center (CC) where a perpendicular from Pt Point intersects Ba-Na (Fig. 3) (Ricketts RM, 1981).

FIGURE 3 Facial growth according to Ricketts. (From Ricketts RM. Perspectives in the clinical application of cephalometrics—the fifty years. Angle Orthod 1981, 51(2):M5.)

Cephalograms taken at different ages and superimposed in this way show orderly apparently radial outward movement of almost all facial structures with growth. Porion, basion, orbitale, nasion, gonial angle, Xi point, gnathion and both molar and incisor teeth follow this pattern. The facial axis has a constant direction, and there is a parallel lowering of the palatal and occlusal planes and of the corpus axis of the mandible. It must be noticed that the pattern is not shared by sella, which is located in the neural cavity or by the anterior nasal spine (ANS) and point A.

Difficulties in cephalometric study came from both the malformation and the surgery. Because of the malformation, we could not use the nasion point and therefore the nasion-basion plane. Because of the surgery, the infraorbital point assumed a modified position and the postoperative Francfort plane was an unreliable landmark. However, it was necessary to adapt this reference frame without changing its conceptual basis for the interpretation of results. The basion-nasion line was replaced by the inferior border of the sphenoidal corpus, because it has nearly the same orientation. Since this line was too short to be a reliable plane of superimposition, we have also used the clivus, the direction of which has been demonstrated to be stable during growth (Thilloy, 1978). Pt was chosen as the registration point. The same orientation of the Francfort plane, as traced on the preoperative radiograph, was used postoperatively, after superimposition of both tracings.
RESULTS

Only four cases will be reported.

Case Study 1

The patient, a girl, had a median craniofacial cleft. She was operated on at the age of 9½ years and the recent documents were assembled 8 years later (Fig. 4A-4D). The nasal septum was totally removed. The root of the nose was rebuilt with a rib graft and 6 months later with another rib graft.

The preoperative tracing showed: marked obliquity (upward and forward) of the palatal plane to PHF: 11 degrees (m=0 degrees ± 2.5 degrees); hyperbrachyfacial type of the mandible (i.e., mandibular bend: 35 degrees [m=23 degrees ± 3.5 degrees at 9 years] and mandibular plane: 15 degrees [m=26 degrees ± 4 degrees at 9 years]); and normal lower facial height: 47 degrees (m=47 degrees ± 4 degrees) (Fig. 4E).

There was a class I molar relationship with a slight proclination of the maxillary incisors.

Superimposition of the preoperative and postoperative cephalometric tracings showed: an important anterior rotation of the mandible with closing of facial axis and flattening of mandibular plane, an almost parallel lowering of the palatal plane (degree of displacement low), a slight forward displacement of the anterior nasal spine, and only minor changes of the shape of the graft (Fig. 4F).

Comparison of the postoperative cephalogram with the predictive tracing allowed the following conclusions to be reached: (1) The degree of mandibular growth corresponded to the forecast. (2) The position of the palate was normal, but there was apparently no forward growth in the region of the anterior nasal spine (Fig. 4G).

Case Study 2

This 9-year-old girl had orbital hypertelorism due to craniosynostosis. The operation was performed at the age of 11 years, and the postoperative examination was done 4 years later (Fig. 5A, 5B). She had a rib graft of the nose, then an iliac graft 1 year later, at the age of twelve.

The preoperative tracing showed: a slight obliquity of the palatal plane, a brachyfacial type of mandible, and a slight class II malocclusion associated with a proclination of upper incisors (Fig. 5C). The skeletal facial pattern was rather similar to the first case.

Superimposition of preoperative and postoperative tracings showed: a slight counterclockwise rotation of the facial axis which means an anterior rotation of the mandible, a lowering and a slight tilting of the palatal plane, which tended to be more horizontal, and a purely vertical displacement of the anterior nasal spine, without anterior movement (Fig. 5D).

Comparison of the forecast with the actual mandible and maxilla showed the following: (1) There was a remarkable likeness of the form of the mandible. The slight difference in superimposition came from the anterior rotation, which was not included in the predictive tracing. (2) On the contrary, there were some changes in the growth of the maxilla. (3) The lowering of the posterior nasal spine was not as important as planned. (4) The lowering of the anterior nasal spine was normal, but there was apparently no forward growth in this area (Fig. 5E, 5F).

Case Study 3

This boy with a frontonasal encephalocele was operated on at the age of 5 years (Fig. 6A, 6B). The postoperative cephalogram was taken 3 years later. A brachyfacial pattern with low mandibular angle (14 degrees) and high mandibular bend (34 degrees) was observed. An important tilting, upward and forward, of the palatal plane (9 degrees) allowed normal lowering of the anterior nasal spine (Fig. 6C). Superimposition of pre- and postoperative tracings showed a good stability of the facial pattern and a lowering of the palatal plane with a slight tipping downward and forward (Fig. 6D).

Comparing postoperative tracing and growth forecast led to conclusions similar to those of previous cases: mandibular growth was quite normal, and maxillary growth was altered. In that case, lowering of PNS seemed insufficient and forward displacement of ANS did not occur (Fig. 6E, 6F).

Case Study 4

This was a girl with craniofacial clefts and encephalocele, operated at 8 years of age (Fig. 7A, 7B). The nasal septum was removed. The follow-up radiograph was taken 10 years later. She had a rib graft and then an iliac graft of the nose. The facial pattern, as shown by the preoperative cephalometric tracing, was completely different from the three other cases. It was quite dolichofacial with high lower facial height (56 degrees) steep mandibular plane (29 degrees) and obtuse mandibular shape (22 degrees). The palatal plane was markedly tipped upward and forward (20 degrees) (Fig. 7C).

Superimposition of pre- and postoperative tracings again showed stability of facial pattern, indicated by constancy of the facial axis. In this kind of skeletal type, growth is predominantly vertical, and lowering of both palatal and mandibular planes occurred here (Fig. 7D).

Comparison of postoperative results and the growth forecast showed that prediction for mandibular growth was rather good. In the premaxillary area, some kind of remodeling with a resorptive pattern of nasal floor had seemed to occur. Anterior displacement of ANS was less than expected (Fig. 7E, 7F).
FIGURE 4  A and B, Condition of patient before and after surgical procedure, C and D, Cephalometric X-ray before and after operation. Rib graft of the nose is 7 years old.
FIGURE 4 (Continued)  E, Preoperative tracing (age 9½ years), F, Superimposition of pre- and postoperative tracings, G, Archial forecast (8 years), H, Superimposition of forecast and actual tracing at 17½ years. (From Lejoyeux E, et al. Croissance maxillaire après résection totale du septum nasal dans les hypertélorismes orbitaires. Orthod Fr 1982; 53(2):403.)
FIGURE 5  A and B, Condition of patients before and after surgery, C, Preoperative tracing (age 9 years), D, Superimposition before and after operation.
FIGURE 5 (Continued)  

E, Archial forecast (6 years), F, Superimposition of forecast and actual tracing at 15 years.  

FIGURE 6  
A and B, Condition of patient before and after surgery.
FIGURE 6 (Continued)  C, Preoperative tracing (age 5 years), D, Superimposition of pre- and postoperative tracings, E, Archial forecast (3 years), F, Superimposition of forecast and actual tracing at 8 years. (From Lejoyeux E, et al. Croissance maxillaire après résection totale du septum nasal dans les hypétélorismes orbitaires. Orthod Fr 1982; 53(2):403.)
FIGURE 7  A and B, Condition of patient before and after surgery, C, Preoperative tracing (age 7 years), D, Superimposition of pre- and postoperative tracings.
DISCUSSION

Before trying to reach any kind of conclusions concerning maxillary growth from this study, it must be remembered that cephalometric procedures of superimposition give an "oriented" picture of growth phenomena that depends on the choice of reference plane and registration point. In any case, they cannot explain what really happened. Cautious interpretation of any result is necessary, especially when surgical procedures have deeply remodeled facial morphology as in this sample. The Ricketts long-term growth forecast is based on computerized studies of a very large sample of normal children. The frame of reference it offers expresses the most probable hypothesis of development. Increments incorporated for elongation of skeletal structures are only means, which cannot be individualized, especially when tracings are made manually as was the case in this study. Nevertheless, it was interesting to note that the patients of Dr. Tessier, although presenting such severe deformities, follow rather closely "normal" facial growth pattern, with good stability of the facial axis and remarkable likeness to the predicted form of the mandible. The main difference observed between the postoperative control radiographs and growth forecast tracings was in all cases located in the premaxillary area, which seemed to exhibit reduced forward growth.

REFERENCES


