A Study of Anthropometric Measures Before and After External Septoplasty in Children

A Preliminary Study

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**Objective:** To test the hypothesis that surgery on the growing nasal septum does not adversely affect nasal and midfacial dimensions.

**Design:** Paired study.

**Setting:** Tertiary care center.

**Participants:** Children treated consecutively during a 4-year period; all had significant nasal obstruction and cosmetic disfigurement secondary to skeletal septal deformities.

**Intervention:** Nasal septal surgery (using an external approach), in which the quadrilateral cartilage was removed, remodeled, and reinserted as a free graft.

**Outcome Measures:** Anthropometric linear measurements and indexes of the face and nose preoperatively and postoperatively; nasal dorsum length, nasal height, nasal dorsum index, nasal tip protrusion, columellar length, facial height, face width, upper face height, facial index, nose–upper face height index, and columellar length–nasal tip protrusion index. Continuous measurements were transformed into ordered categories with reference to normative data. Data were analyzed using Wilcoxon signed rank sum test (α level of .05) and by applying the Bonferroni adjustment for multiple testing.

**Results:** Twenty-six children were studied (12 females and 14 males); age at surgery ranged from 4.5 to 15.5 years (mean age, 9.5 years); average age at postoperative measurement, 12.5 years; mean follow-up, 3.1 years. Only nasal dorsum length (P = .007) and nasal tip protrusion (P = .04) were decreased by a statistically significant level before the Bonferroni adjustment. The change was not considered clinically significant. Thus, relative to age-appropriate norms, the dimensions of the nose and midface and their proportionality did not change after surgery.

**Conclusions:** Appropriate nasal septal surgery involving excision and subsequent reinsertion of a remodeled segment of the quadrilateral cartilage has no deleterious effects on development of the nose and midface. We question the absolute dogma that nasal surgery in children must always be avoided.


Surgery on the growing nasal septum has always been the epicenter of debates. The sources of such debates are the controversial findings and views found in human and animal studies. As observed by Freng and Haye, views based on animal studies vary according to the model implemented (species, surgical procedure, and age of animals). At the same time, interventional clinical studies in humans have failed to provide good evidence for accepted practice. Consequently, blanket statements urging caution are common in the literature, as Gilbert et al write:

Because the quadrilateral septal cartilage is the keystone in development of the profile projection of the cartilaginous vault, dare we either chip away at it or even undermine it without fear of subsequent interference with the continuous profile growth of the cartilaginous vault in children?²

The conclusion of Farrior and Connolly³ after their review of the literature appears fairly balanced, despite the lack of supporting evidence. They recommended that surgery (as conservative as possible) be delayed until nearly full development has taken place, unless marked disturbance in function or distortion exists that also interferes with growth and facial development.

All human studies of pediatric septoplasty will, unavoidably, be confounded by the previous trauma and its effects, making it difficult to attribute to either the sur-
MATERIALS AND METHODS

The database kept by one of us (W.S.C.) holds the medical records of patients who have undergone septoplasty and/or rhinoplasty and were treated during a 13-year period (1986-1999). All patients whose anthropometric measurements were recorded preoperatively were identified. Preoperative anthropometric measurements have been recorded routinely by one of us (W.S.C.) since early 1995. For the purpose of this investigation, we included only those patients whose septoplasty had been performed via the external approach and in whom the free graft technique (previously described6,12,13) had been used. We considered only those who had undergone the procedure before 16 years of age, as different nasal measurements reach maturation at variable ages (between 14 and 16 years), and these vary further between sexes.14

Subsequent to approval by the relevant ethics committee, the patients’ addresses and telephone numbers were retrieved from the Health Records department of The Hospital for Sick Children, Toronto, Ontario. The patients were then contacted by mail and telephone and solicited to attend a specific appointment at the Craniofacial Measurements Laboratory at The Hospital for Sick Children. The consent of parents and children were obtained as appropriate, after explanation of the purpose of the examination.

The measurements were performed by one of us (L.G.F.) according to a standard technique with the use of sliding and spreading calipers,15 and proportions were calculated using standard formulae.16

The anthropometric linear measurements used are illustrated in Figure 1, and the indexes were calculated from their values. Although the linear measurements are individual dimensions in their own right, the indexes or proportions demonstrate the harmony between these dimensions. Together, they indicate some aspects of nasal and facial growth. The variables used as outcome measures (many of which are illustrated in Figure 1) were as follows:

• Nasal dorsum length
• Nasal height
• Nasal index or (n to prn)/(n to sn), ie, the nasal dorsum length (nasion [n] to pronasale [prn]) divided by the nasal dorsum height (n to subnasale [sn])
• Collumellar length
• Nasal tip protrusion
• Collumellar length–nasal tip protrusion index or (sn to c’)/(sn to prn), ie, the relationship between the collumellar length (sn to apex of columella [c’]) and the nasal tip protrusion (sn to prn)
• Facial height
• Face width
• Facial index or (n to gn)/(zy to zy), ie, the relationship between the facial height (n to gnation [gn]) and the face width (distance from one zygion [zy] to the other)
• Upper face height
• Nose–upper face height index or (n to sn)/(n to sto), ie, the relationship between the nasal height (n to sn) and the upper face height (n to sto).

All measurements were in millimeters.

The linear measurements and indexes before and after surgery were transformed into 1 of 5 possible ordered categories (−2, −1, 0, 1, and 2). These indicate whether the measured variable is subnormal, borderline small, optimal, borderline large, or supernormal, respectively, as compared with documented norms of North American whites.15 An optimal measurement or proportion is within 1 SD from the mean, whereas borderline (small or large) values lie within 2 SDs. Abnormally large or small measurements are those values beyond 2 SDs from the mean.

The Wilcoxon signed rank test was applied to the paired differences between each of the ordered measurements to determine whether they changed after surgery. A Bonferroni adjustment for multiple testing was performed (κ × P), and the interpretation of our results was based on the adjusted P values. Ninety-five percent confidence intervals were computed for the medians of the paired differences.17

The spreadsheet from the computerized database (created using Microsoft Excel software [Microsoft Corporation, Redmond, Wash]) contains records of 295 patients who were operated on between January 1, 1986, and December 31, 1999, in The Hospital for Sick Children. We identified 40 patients who qualified for the entry criteria. Eight patients could not be contacted with the available addresses or telephone numbers, and we had no access to their new locations. The remaining 32 were contacted by mail and telephone and were invited for follow-up. Only 1 parent declined initially, and another 5 patients failed to attend.

The study patients were treated between March 1, 1995, and December 31, 1999. Their follow-up ranged from 10 months to 5.4 years (mean, 3.1 years). Twelve were females and 14 were males, with an age range (at operation) from 4.5 to 15.5 years (mean age, 9.5 years).
(Average age at postoperative measurement, 12.5 years.) Seven patients had isolated cleft lip and/or palate and 1 had Crouzon syndrome. 16 had previously undergone septoplasty. The patients fell into 4 different ethnic groups: most (n=14) were whites of European descent, 7 were East Indians, 4 were whites of Middle Eastern descent, and 1 was West Indian.

Altogether, 26 rhinoplasty maneuvers were performed in addition to the free-graft septoplasty in all the patients: 14 dorsal grafts, 4 columnellar struts, 4 dome sutures, 2 lower lateral cartilage trimmings, and 2 tip grafts. None of the patients underwent an osteotomy. Only 2 postoperative complications had been recorded: 1 vestibular granuloma that required resection and 1 postoperative epistaxis that required packing for control.

The variables for all patients were available for analysis, with 3 exceptions. One measurement for the columellar length was not documented. Also, in both the columellar length–nasal tip protrusion index and nose–upper face height index, there were no available norms for children younger than 5 years, which led to the omission of 1 patient who was aged 4½ years at the time of surgery.

The details of the paired analysis are presented in Table 2 and Table 3. They demonstrate that only 2 of the differences between the medians were statistically significant before the Bonferroni adjustment (the nasal dorsum length [P=.007] and nasal tip protrusion [P=.04]). After adjustment (multiplication by the number of variables, i.e., 11), this significance was lost. Two more important observations support this notion. First, if the confidence intervals are examined, it will be observed that they all encompass the 0, i.e., no difference between medians, indicating that the significance of the P values is not supported. Second, the median differences are either 0 or 0.5; in other words, the change is less than 1 ordered category, which cannot be clinically significant. Also, none of the indexes changed significantly, since they represent proportionality measures between individual linear dimensions.

However, since the 2 variables under scrutiny are a reflection of the length of the nose, there may be a trend toward some shortening of the noses that were operated on. The data pertaining to the nasal dorsum length in particular is described in Figure 2. The numbers of the patients in each ordered category are plotted for preoperative and postoperative status. Note that the numbers of patients are increasing in the categories indicating smaller lengths. This strengthens the impression of the trend already mentioned.

Our study documents that these children did not exhibit clinically significant retardation of growth after external approach septoplasty using quadrilateral cartilage as a free graft. This extrapolation derives from the categorization of the postoperative anthropometric measurements in relation to documented norms for North American whites, which was not significantly different from the preoperative status. However, there is an observed trend for the noses operated on to shorten, as noted in the results of 2 variables.

This is the first longitudinal clinical study on pediatric septoplasty, to our knowledge, to use objective mea-

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**Table 1. Major Clinical Studies in Pediatric Septoplasty**

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of Patients</th>
<th>Design</th>
<th>OCM</th>
<th>Rhinoplasty</th>
<th>Septoplasty</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crysdale and Tatham, 1985</td>
<td>15</td>
<td>Retrospective</td>
<td>Subjective</td>
<td>Yes</td>
<td>Mixture of techniques</td>
<td>Open</td>
</tr>
<tr>
<td>Walker et al, 1993</td>
<td>16</td>
<td>Retrospective</td>
<td>Nasal airflow studies (9) Anthropometry (10)</td>
<td>Yes</td>
<td>Excision and reimplantation</td>
<td>Open</td>
</tr>
<tr>
<td>Bejar et al, 1996</td>
<td>33</td>
<td>Retrospective</td>
<td>Anthropometry (10)</td>
<td>Yes</td>
<td>Excision and reimplantation</td>
<td>Open</td>
</tr>
<tr>
<td>Triglia et al, 1990</td>
<td>28</td>
<td>Retrospective</td>
<td>Subjective</td>
<td>Yes</td>
<td>Mixture of techniques</td>
<td>Open (20)</td>
</tr>
<tr>
<td>Jugo, 1987</td>
<td>24</td>
<td>Retrospective</td>
<td>Subjective</td>
<td>No</td>
<td>Excision and reimplantation</td>
<td>Closed (8)</td>
</tr>
<tr>
<td>Ortíz-Monasterio and Olmedo, 1981</td>
<td>44</td>
<td>Retrospective</td>
<td>Subjective</td>
<td>Yes</td>
<td>Mixture of techniques</td>
<td>Open</td>
</tr>
<tr>
<td>Jennes and Waterbury, 1964</td>
<td>8</td>
<td>Case reports</td>
<td>Cephalometry</td>
<td>No</td>
<td>Mixture of techniques</td>
<td>Closed</td>
</tr>
<tr>
<td>Healy, 1986</td>
<td>10</td>
<td>Retrospective</td>
<td>Subjective</td>
<td>No</td>
<td>Morselization and replacement</td>
<td>Sublabial</td>
</tr>
</tbody>
</table>

*All studies used descriptive analysis. Data in parentheses are number of patients. OCM indicates outcome measures.*
been documented. After noting these facts and the oc-

regeneration and survival after autotransplantation had

examination had been performed, evidence of cartilage

results.

even though they preserved the mucoperichondrium.20

have reproduced the same results in the same species,

but for successful pediatric septoplasty.

At this stage, and since the study contributes sig-

that was subsequently relieved by surgery. The indica-

documented sleep apnea due to nasal airway obstruction

except for one of the patients in this series who had

sures in a paired design. With individual patients acting

controls, the confounding effect of the heter-

genosity of the sample (ie, inclusion of patients with

be required for successful pediatric septoplasty.

preserves the integrity of the mucoperichondrium and

results will only be possible by using a technique that

growth retardation in children. Achievement of these

orraine of duplication and deviations after the use of

autografts, Nolst Trenite and colleagues21 stated that possible

adjustments in operative techniques to achieve a bet-

teronal connection between parts of septal cartilage with a

prolonged fixation of the septum in the midline might

be required for successful pediatric septoplasty.

Finally, it is pertinent to examine some of the litera-

ture that deals with patterns of growth of the nasal septal

cartilage. In this context, Van Loosen and coworkers had

shown in 199626 and 199727 that the growth of the nasal

septum decelerates remarkably after age 2 years and that

it reaches a plateau by age 36 years. They also postulated

that the septal cartilage reaches adult size by age 2 years

and that further growth occurs courtesy of the bony per-

pendicular plate. They did not document any particular

spurts of growth at any ages. Recent work from Brazil26

adds that there is histological evidence of a reduction in

the rate of growth of the quadrilateral cartilage by age 5

years and that deceleration starts by age 8 years.

The philosophy of the intervention used in this

group of patients respects these issues. This intervention is

based on a conservative technique that emphasizes

precision in the preparation of a carefully sized and

shaped graft and in its method of fixation.6,12,13 Equally

important are the patient choice and the indication for

surgery. The age limit has never fallen below 6 years,

except for one of the patients in this series who had

documented sleep apnea due to nasal airway obstruction

that was subsequently relieved by surgery. The indica-

tion for this type of surgery is severe nasal obstruction

associated with external deformity. In particular, septal

deformities anterior to the anterior nasal spine are the

specific abnormality addressed by this technique. These

patients are always scrutinized for causes of obstruction

other than the septum.

In conclusion, we believe that, where indicated, re-

constructive septal surgery does not cause significant

growth retardation in children. Achievement of these

results will only be possible by using a technique that

preserves the integrity of the mucoperichondrium and

restores skeletal continuity (by using refashioned quad-

rilateral cartilage as free graft) as much as possible, along

with meticulous fixation of the reconstructed septum.

This is not an open invitation for septal surgery in any

deviated pediatric nasal septum or by an inexperienced

surgeon.

<table>
<thead>
<tr>
<th>Linear Measurement</th>
<th>No. of Patients</th>
<th>Wilcoxon Statistic</th>
<th>P Value</th>
<th>Difference, Median (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal dorsum length</td>
<td>26</td>
<td>74.0</td>
<td>.007</td>
<td>0.5 (0.0 to 1.0)</td>
</tr>
<tr>
<td>Nasal height</td>
<td>26</td>
<td>56.0</td>
<td>.85</td>
<td>0 (-0.5 to 0.5)</td>
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<tr>
<td>Columellar length</td>
<td>25</td>
<td>16.0</td>
<td>.48</td>
<td>0 (-0.5 to 0.0)</td>
</tr>
<tr>
<td>Nasal tip protrusion</td>
<td>26</td>
<td>19.5</td>
<td>.04</td>
<td>-0.5 (-0.5 to 0.0)</td>
</tr>
<tr>
<td>Face height</td>
<td>26</td>
<td>12.0</td>
<td>.80</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Face width</td>
<td>26</td>
<td>14.0</td>
<td>.53</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Upper face height</td>
<td>26</td>
<td>42.0</td>
<td>.83</td>
<td>-0.5 (-0.5 to 0.5)</td>
</tr>
</tbody>
</table>

*P values depicted are before Bonferroni adjustment, ie, multiplication by 11. CI indicates confidence interval.

<table>
<thead>
<tr>
<th>Indexes</th>
<th>No. of Patients</th>
<th>Wilcoxon Statistic</th>
<th>P Value</th>
<th>Difference, Median (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal</td>
<td>26</td>
<td>48.0</td>
<td>.20</td>
<td>0 (0.0 to 0.5)</td>
</tr>
<tr>
<td>Facial</td>
<td>25</td>
<td>36.0</td>
<td>.84</td>
<td>-0.5 (-0.5 to 0.0)</td>
</tr>
<tr>
<td>Columellar length–nasal tip protrusion</td>
<td>24</td>
<td>75.0</td>
<td>.74</td>
<td>-0.5 (-0.5 to 0.5)</td>
</tr>
<tr>
<td>Nose–upper face height</td>
<td>25</td>
<td>47.0</td>
<td>.23</td>
<td>0 (0.0 to 0.5)</td>
</tr>
</tbody>
</table>

*P values depicted are before Bonferroni adjustment, ie, multiplication by 11. CI indicates confidence interval.

\[ \text{Table 2. Results of Paired Analysis for Linear Anthropometric Measurements, Comparing Preoperative and Postoperative Status}^{*} \]

\[ \text{Table 3. Results of Paired Analysis for Indexes, Comparing Preoperative and Postoperative Status}^{*} \]
REFERENCES


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