Effects of Von Langenbeck Palatoplasty on Facial Growth

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Different surgical procedures have been suggested for palatal repair. Some of these palatoplasties have withstood the test of time, others have fallen into disfavor because of their obvious deleterious effects on facial and dental growth and speech.

Of the palatoplasties which are still popular, Levin[5] found that the Von Langenbeck is used by about fifty percent of the surgeons in the United States and Canada. Because of such a widespread adoption of this procedure a detailed study on the over-all effects of the Von Langenbeck palatoplasty seems both desirable and necessary.

The purpose of this study is to: a) describe the facial and dental morphology of individuals with isolated clefts of the palate repaired by the Von Langenbeck palatoplasty; b) compare facial morphology of these patients with a matched sample of noncleft subjects at two different ages (pre- and post-adolescent). The data for this study were obtained from lateral X-ray cephalograms and standardized facial photographs.

LITERATURE REVIEW

To determine the validity of previously expressed objections of other investigators on the results of the Von Langenbeck palatoplasty, Palmer et al.[8] examined 17 individuals (mean age 3.5 years) with different types of clefts, operated using the Von Langenbeck procedure, and 71 individuals (mean age 4 years) operated using the push-back procedure. They found the incidence of anterior crossbite and buccal-segment collapse to be markedly less in the Von Langenbeck group. The speech results were also better and the authors concluded that the simpler the surgical technique, the fewer the maxillary deformities. It was their opinion that the pushback was a more complex procedure and therefore necessitated more tissue dissection.

Jolleys[3] examined two groups of patients with complete clefts who had palatal surgery before two years of age, one group had a Wardill procedure while the second had a Von Langenbeck operation. He found that the latter group had "slightly better" maxillary growth.

Linday[6] summarized the original Von Langenbeck palatoplasty by stating, "The uranoplasty (hard palate) consists of the following stages whether staphylorrhaphy (soft palate) is done at the same time or not: 1) incising the edges of the cleft, 2) division of the palatine musculature, 3) lateral incision, 4) detaching the mucoperiosteal flaps of the palate, 5) application of sutures."

Lindsay further indicated that Von Langenbeck[10] retained an anterior attachment for the flaps and avoided ligation of the palatine neurovascular bundles. He also denuded the free border of the nasal septum for attachment of the palatal flap.

The procedure performed on the Iowa cleft sample was essentially the same but in addition the tendon of the tensor veli palatine was slipped off the

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hamular process or the process itself was fractured.

The review of the literature pointed to the need for a study which exclusively evaluates the effect of the Von Langenbeck palatoplasty on facial growth. This can be achieved only if the effects of other variables, e.g., lip surgery, are eliminated.

Materials and Methods

A total of 165 individuals with isolated clefts of the palate were seen and treated between the years of 1954-1966 in the Cleft Palate Center at Iowa. Of these, a total of fifty-five individuals (34 females and 21 males) were operated using the Von Langenbeck palatoplasty.

To insure the homogeneity of the cleft sample all individuals in this study were Caucasians, all were females, all had isolated clefts of the palate, all operated by the Van Langenbeck palatoplasty mostly by one surgeon and none had Piere Robin syndrome. Thirty-three individuals met these specifications. These were divided into two groups, young and old. Nine individuals were included in both groups since records were available on them at both ages.

The young cleft group included 28 individuals with a mean age of 9.8 years, between 8.1 and 10.6 years, while the old cleft group included 14 individuals with a mean age of 17.5 years between 15.0 and 21.5 years. None of the cleft sample included individuals with bifid uvulas and both groups had a proportionate distribution of similar cleft types. Thus the young group included 17 individuals with clefts of the soft and hard palates (60.7%) while the old group included 8 individuals with the same type of clefts (57.1%).

A matched normal (noncleft) sample of 57 individuals was selected from an Iowa school population and was divided into a young group of 32 children with a mean age of 8.2 years, between 6.9 and 9.7 years, and an old group of 25 individuals with a mean age of 19.4 years between 18.2 and 23.4 years.

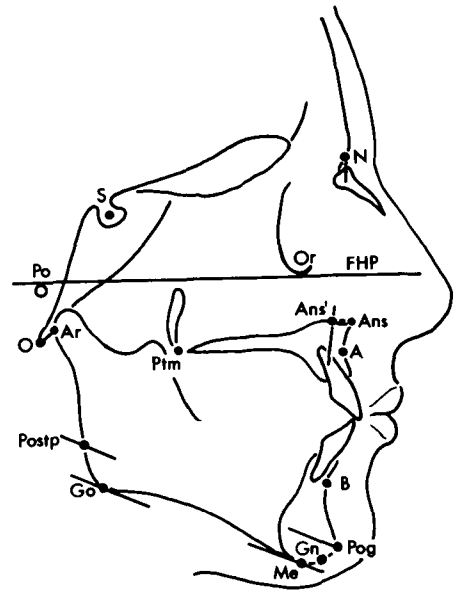

Fig. 1 Landmarks used.

Lateral X-ray cephalograms of all subjects were taken with the head oriented in Frankfort horizontal and the teeth in occlusion.

The following points were identified on each lateral X-ray film for use as measurement landmarks (Fig. 1): sella (S), nasion (N), subspinale (A), supramentale (B), pogonion (Pog), gnathion (Gn), menton (Me), gonion (Go), pterygomaxillary fissure (Ptm), anterior nasal spine (Ans), Ans', located by dropping a perpendicular from Ans on the N-Me line, postpogonion (Postp), anterior-most point of occipital condyle (O) and articulare (Ar). The detailed definition of these landmarks is published elsewhere.[2,4,7,9] For all bilateral landmarks the midpoint between projections was used where appropriate.

The following angles were measured on each cephalogram: SNO, SNA, SNAns, SNB, SNPog, NSGn, NAPog, and ANB.

Three additional angles, MP-SN (relating the lower border of the mandible to the anterior cranial base), 1:MP (long axis of the mandibular incisor to the mandibular plane), and the angle between SN and the long axis of the upper central incisor (1:SN) were measured.

The following linear lengths were made: N-O (total cranial base); S-N (anterior cranial base); Ans-Ptm (maxillary depth); N-Me (total face height); N-Ans′ (upper face height), Ans′ used instead of Ans to eliminate the influence of variations in the anteroposterior position of Ans on measurements of upper face height; Ar-Go (ramal height); and finally, Pog-Postp for mandibular depth. All linear measurements were corrected for magnification.

Five different ratios or indices of craniofacial form were computed using many of the above linear measurements. Such indices are useful in the identification of possible intergroup differences in shape or form, as assumed from differences in absolute size. The ratios derived were: N-Ans′/N-Me, Ans-Ptm/S-N, N-Ans′/S-N, S-N/N-Me, Ans-Ptm/Pog-Postp, N-S/N-O, and Ar-Go/N-Me.

The technique for obtaining data on the eleven angular and seven linear dimensions was based on methods previously reported[1,2] which included a) the independent acquisition of double sets of measurements by each of two investigators; b) the elimination by each investigator of excessive measurement disagreements with self; c) the averaging by each investigator of his own double determination data; and d) the averaging of the individual measurements of the two investigators to yield the final set of data for analysis.

Means, standard deviations and standard error statistics for the parameters examined were calculated and t-tests were performed to test the hypothesis of no difference between the cleft and normal population means. Significance was predetermined at the .05 and .01 levels of confidence.

Findings

The detailed basic statistics on the four groups examined are presented in Tables I and II. Scores of t-tests resulting from the comparisons of the different groups are presented in Table III.

The various cephalometric measurements enumerated earlier will be grouped to describe the following parameters: maxillary complex, mandible, maxillary-mandibular relations, face heights, normal base and dental relations.

Comparisons Between Normal and Cleft Individuals

Maxillary Complex: The maxillary relation (SNA and SNAns) was found to be significantly more retruded in the young cleft group than in the normal group. No significant differences were found in the old group comparisons. Maxillary depth (Ans-Ptm) was significantly shorter in both the young and the old cleft groups; the ratio Ans-Ptm/S-N expressed the same tendency.

Mandible: The mandible was significantly more retruded (SNB, SNPog and MP-SN) and mandibular depth (Pog-Postp) was significantly shorter in the young cleft group as compared with its corresponding normal group.

Maxillary-Mandibular Relations: No significant differences were found between the young normal and cleft groups in maxillary-mandibular relations (ANB, NAPog and Ans-Ptm/Pog-Postp). On the other hand, the angle

TABLE I

Statistics on 24 measurements from lateral cephalograms for young normal and CPO individuals

Measurement	Young Normals N=32			Young Clefts N=28		
	$\bar{x}$	S.D.	S.E.	$\bar{x}$	S.D.	S.E.
Maxilla:						
SNA (°)	81.0	4.0	0.8	77.7	3.9	0.7
SNAns (°)	85.9	4.0	0.8	82.8	4.5	0.8
Ans-Ptm (mm)	49.3	2.1	0.4	44.8	2.5	0.4
$\frac{\text{Ans-Ptm}}{\text{S-N}}$ (x100)	76.5	4.1	0.8	73.4	4.1	0.7
Mandible:						
SNB (°)	78.0	2.7	0.5	75.4	4.3	0.8
SNPog (°)	79.4	2.8	0.5	75.9	3.8	0.7
MP:SN (°)	32.7	4.2	0.8	39.0	5.0	0.9
Pog-Post (mm)	73.5	4.0	0.8	66.6	4.0	0.7
Maxilla-Mandible:						
ANB (°)	3.0	1.9	0.3	2.4	2.5	0.4
NAPog (°)	3.5	4.5	0.9	3.8	5.8	1.1
$\frac{\text{Ans-Ptm}}{\text{Pog-Postp}}$ (x100)	67.2	4.3	0.8	67.4	3.7	0.7
Facial Heights:						
N-Me (mm)	102.3	4.5	0.9	99.8	5.8	1.1
N-Ans' (mm)	45.3	2.9	0.5	42.6	3.5	0.6
Ar-Go (mm)	42.7	3.1	0.6	39.8	3.7	0.7
$\frac{\text{N-Ans'}}{\text{N-Me}}$ (x100)	44.3	2.1	0.4	42.8	2.9	0.5
$\frac{\text{Ar-Go}}{\text{N-Me}}$ (x100)	41.8	3.1	0.6	39.9	3.2	0.6
Cranial Base:						
NSO (°)	127.6	4.8	0.9	126.4	5.6	1.0
N-O (mm)	64.4	2.1	0.4	61.1	2.7	0.5
S-O (mm)	94.0	3.4	0.6	88.3	4.5	0.8
N-S (mm)	39.6	2.9	0.5	37.0	2.6	0.4
$\frac{\text{N-S}}{\text{N-O}}$ (x100)	68.6	1.7	0.5	69.3	2.4	0.4
Dental:						
$\underline{1}$:SN (°)	102.0	7.2	1.4	100.0	9.4	1.7
$\bar{1}$:MP (°)	93.4	6.2	1.2	84.6	6.9	1.3
$\underline{1}:\bar{1}$ (°)	131.8	10.5	2.1	139.4	8.4	2.3

TABLE II
Statistics on 24 measurements from lateral cephalograms for old normal and CPO individuals

	Old Normals N-25			Old Clefts N=14		
Measurement	$\bar{x}$	S.D.	S.E.	$\bar{x}$	S.D.	S.E.
Maxilla:						
SNA (°)	79.5	3.3	0.5	76.8	5.7	1.5
SNAns (°)	85.2	3.6	0.6	82.0	6.1	1.6
Ans-Ptm (mm)	50.8	3.3	0.5	46.2	3.2	0.8
$\frac{\text{Ans-Ptm}}{\text{S-N}}$ (x100)	77.7	4.6	0.8	71.3	6.3	1.6
Mandible:						
SNB (°)	77.6	3.1	0.5	76.1	6.1	1.6
SNPog (°)	78.9	3.2	0.5	78.2	4.9	1.3
MP:SN (°)	32.6	5.9	1.0	36.0	7.1	1.9
Pog-Post (mm)	75.6	4.0	0.7	75.6	4.9	1.3
Maxilla-Mandible:						
ANB (°)	2.0	2.5	0.4	0.7	2.9	0.7
NAPog (°)	1.4	6.3	1.1	-2.9	7.6	2.0
$\frac{\text{Ans-Ptm}}{\text{Pot-Postp}}$ (x100)	67.3	5.5	0.9	61.2	3.8	1.0
Facial Heights:						
N-Me (mm)	108.0	6.0	1.0	110.1	6.2	1.6
N-Ans' (mm)	47.0	2.2	0.3	47.6	2.9	0.8
Ar-Go (mm)	46.9	4.7	0.8	47.8	2.5	0.6
$\frac{\text{N-Ans'}}{\text{N-Me}}$ (x100)	43.5	2.2	0.4	43.3	2.8	0.7
$\frac{\text{Ar-Go}}{\text{N-Me}}$ (x100)	43.5	4.9	0.8	43.5	3.7	0.9
Cranial Base:						
NSO (°)	129.5	4.5	0.8	126.8	6.6	1.7
N-O (mm)	65.3	2.4	0.4	64.9	3.3	0.9
S-O (mm)	94.5	3.8	0.6	92.4	4.2	1.1
N-S (mm)	38.5	2.2	0.4	37.6	2.9	0.7
$\frac{\text{N-S}}{\text{N-O}}$ (x100)	69.1	1.9	0.3	70.2	2.8	0.7
Dental:						
$\underline{1}$:SN (°)	103.0	7.7	1.3	101.8	10.7	2.8
$\overline{1}$:MP (°)	93.2	8.6	1.5	85.3	8.3	2.2
$\underline{1}:\overline{1}$ (°)	131.3	10.8	1.9	142.5	9.6	1.6

TABLE III
Student t-test scores for comparisons between and within normal and cleft groups

Measurement	Young Normal vs Young Cleft		Old Normal vs Old Cleft		Young Normal vs Old Normal		Young Cleft vs Old Cleft	
	F-ratio	t-test	F-ratio	t-test	F-ratio	t-test	F-ratio	t-test
Maxilla:								
SNA (°)	1.0	2.9**	2.9*	1.6	1.4	1.5	1.2	0.3
SNAns (°)	1.2	2.6*	2.8*	1.8	1.2	0.7	1.0	0.0
Ans-Ptm (mm)	1.4	6.9**	1.0	4.3**	2.4*	-2.0*	2.5	-0.9
$\frac{\text{Ans-Ptm}}{\text{S-N}}$ (x100)	1.0	2.7**	1.8	3.8**	1.2	-1.0	2.1	0.7
Mandible:								
SNB (°)	2.4*	2.6**	3.8**	0.8	1.2	0.5	1.0	-0.1
SNPog (°)	1.7	3.7**	2.3*	0.4	1.2	0.6	1.1	-0.6
MP:SN (°)	1.4	-4.8**	1.4	-1.7	1.9	0.1	1.1	0.4
Pog-Post (mm)	1.0	6.2**	1.5	0.0	1.0	-2.0*	1.0	-3.3**
Maxilla-Mandible:								
ANB (°)	1.6	0.9	1.3	1.4	1.6	1.6	1.1	1.3
NAPog (°)	1.6	-0.2	1.4	2.0*	1.9	1.3	1.7	1.4
$\frac{\text{Ans-Ptm}}{\text{Pog-Postp}}$ (x100)	1.3	-0.1	2.1	3.7**	1.6	-0.0	1.0	2.7*
Facial Heights:								
N-Me (mm)	1.7	1.7	1.0	-1.0	1.7	-3.9**	1.0	-3.9**
N-Ans' (mm)	1.4	3.0**	1.8	-0.8	1.7	-2.3*	1.0	-4.2**
Ar-Go (mm)	1.4	2.9**	3.3*	-0.7	2.2*	-3.9**	1.1	-4.9**
$\frac{\text{N-Ans'}}{\text{N-Me}}$ (x100)	1.9	2.1*	1.5	0.3	1.1	1.3	1.1	-0.2
$\frac{\text{Ar-Go}}{\text{N-Me}}$ (x100)	1.0	2.1*	1.7	0.0	2.5*	-1.6	1.0	-1.4
Cranial Base:								
NSO (°)	1.3	0.8	2.1	1.5	1.1	-1.5	1.2	0.0
N-O (mm)	1.6	4.8**	1.9	0.4	1.3	-1.4	1.4	-2.4*
S-O (mm)	1.8	5.0**	1.2	1.6	1.2	-0.5	1.3	-2.9**
N-S (mm)	1.2	3.4**	1.6	1.0	1.6	1.6	1.2	-1.1
$\frac{\text{N-S}}{\text{N-O}}$ (x100)	1.9	-1.1	2.1	-1.5	1.2	-1.1	1.5	-0.7
Dental:								
$\underline{1}$:SN (°)	1.7	0.8	1.9	0.4	1.1	-0.5	1.6	-0.5
$\overline{1}$:MP (°)	1.2	4.8**	1.0	2.8**	1.8	0.13	1.1	-1.0
$\underline{1}$:$\overline{1}$ (°)	2.2	0.4	3.2	0.8	1.0	0.1	1.0	0.1

* Significant at the .05 level of Confidence;
**Significant at the .01 level of Confidence.

of convexity and the ratio Ans-Ptm/Pog-Postp were significantly smaller in the old cleft group.

Facial Heights: Upper face height (N-Ans'), posterior face height (Ar-Go) and the ratio N-Ans'/N-Me were significantly smaller in the young cleft group than in the normal group. All measurements and ratios of facial heights were not significantly different in the old cleft and normal group comparisons.

Cranial Base: All linear measurements of the cranial base (N-S, S-O, N-O) were significantly smaller in the young cleft group; the ratio N-S/S-O

was not significantly different between the young cleft and normal groups. None of the cranial base parameters measured were significantly different in the old group comparisons.

Dental Relations: In both the young and old group comparisons the lower incisors (1:MP) were significantly more lingually positioned in the cleft groups when compared with the normal groups.

Comparisons Between Young and Old Normal Individuals

Both the angular measurements and the ratios were not significantly different between the young and old normal groups. On the other hand, all linear measurements with the exception of those related to the cranial base were significantly larger in the old normal group.

It should be pointed out the young-old comparisons are based on cross-sectional data.

Comparisons Between Young and Old Cleft Individuals

No significant differences were present in any of the angular measurements of the young and old cleft groups. All linear measurements were significantly larger in the old group with the exception of the maxillary depth (Ans-Ptm) and posterior cranial base depth (S-O). Ratio Ans-Ptm/Pog-Postp was significantly smaller in the old cleft group.

Discussion

The findings in this investigation indicate that there were significant differences between the normal and cleft individuals. In a previous investigation[1] it was suggested that these differences between cleft and normal groups should not be solely attributed to palatal surgery. Such differences could, in addition, be part of a genetic pattern characteristic of the cleft palate face or it could be mechanically compensatory to the cleft defect.

This study is not intended to define the relative roles these variables play, rather it is an attempt to find how the interactions between these variables affect the facial and dental structures. These interactions resulted in differences between the cleft and normal groups that were outlined earlier. It is important to us to determine whether these differences are apt to result in facial morphology which is characteristic of individuals with isolated clefts of the palate who had their palatal defects repaired using the Von Langenbeck palatoplasty.

Standardized frontal and profile photographs available on the cleft individuals were used to clinically and subjectively judge whether the middle third of the face is selectively inhibited in the operated cleft group. The profile photographs in particular should reflect the presence of such a general trend.

The facial photographs were divided according to age into the same two groups previously described. Figures 2 and 3 present what a panel of five orthodontists considered as having the most harmonious (esthetically pleasing) as well as the least harmonious faces in the two age-groups. By looking at the choices of these judges one can attest to the absence of a consistent tendency for maxillary retrusion in these patients. Even in Figure 3-d the relative retrusion of both the upper and lower lips was accentuated by the exceptionally pronounced soft tissue chin and nose.

Conclusions

The conclusion derived from this study is that the Von Langenbeck palatoplasty as performed on the cleft individuals evaluated here did not produce gross discrepancies in the dento-

Fig. 2 Representative of the most (a and b) and least (c and d) harmonious faces chosen from the young cleft group.

Fig. 3 (Representative of the most (a and b) and least (c and d) harmonious faces chosen from the old cleft group.

facial structures or relations examined. On the average, the skeletal and profile relations of the maxilla to the mandible can be considered within the acceptable range. With this in mind, speech becomes a more crucial parameter in evaluating the over-all results of this procedure.

Other dental parameters, e.g., incidence of crossbite, arch collapse, etc., need to be examined if a complete evaluation of the results of palatal surgery is desired. This should be done after all orthodontic treatment has been completed and all retainers removed.

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