Comparisons of the Effect of Two Palatoplasties on Facial and Dental Relations

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Introduction

Management of individuals with facial clefts is a complex procedure, involving many disciplines. Because of this complexity many treatment procedures and treatment plans have been devised and implemented. As expected, good but diversified, and sometimes contradictory, ideas resulted in some confusion as to which procedure is the best.

It becomes, therefore, a necessity to scientifically evaluate all treatment approaches available to us and consequently to determine which approach should be implemented to achieve optimal overall results.

Purpose of the Study

It is the purpose of this study to compare the facial and dental relations of two groups of individuals with isolated clefts of the palate. One group was operated using the V/W-Y (Wardill-Kilner) palatoplasty accompanied by severance of the posterior palatine neurovascular bundles, the second group was operated using the "conventional" V/W-Y palatoplasty; i.e., the posterior palatine neurovascular bundles were left intact.

Literature Review

Handling the posterior palatine neurovascular bundles during palatal surgery is a matter of controversy.

The importance of preservation of the blood supply to the palate has been emphasized by Edgerton (*9*). He feels that its preservation not only increases the safety of the operation but helps maintain the bulk and function of the palate and tends to reduce the developmental arrest of the palatal bone.

Broadbent and Hochstrassen (*6*) state that any procedure which electively or inadvertently sections the greater and lesser palatine nerves and accompanying vessels might denervate the mucous glands of the soft palate and might also lead to shortening of palatal length. Their conclu-

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This investigation was supported in part by USPHS research grant DE-00853 and DE-46898, National Institute of Dental Research, Bethesda, Maryland.

sions were based on two patients in which the left neurovascular bundle was sectioned; both cases showed a 3.0 to 3.5 mm longer palate on the control or normal side.

According to Millard (*14*) the Dorrance procedure involves dividing the great palatine vessels and in the Wardill-V-Y Push Back the posterior palatine vessels are also divided. Kilner modified the V-Y Push Back by preserving the neurovascular bundle and lengthening by freeing without cutting the nasal mucosal attachment to the hard palate. Millard also states that some surgeons have "divided the main posterior vascular bundle, and that many times during surgery these bundles have been inadvertently injured, with flap mishap." Millard believes the push back flap to be graced by a generous blood supply from the descending palatine and palatine branch of the ascending pharyngeal artery as well as branches from the tonsils and cheek. Millard himself modified the Dorrance procedure of push-back by the island flap technique which does not involve severing the neurovascular bundle.

Vascular x-rays were used by Checkovsky (*7*) on 21 dogs to test the condition of nourishment in the soft tissues of the osseous palate after intentional resection of the neurovascular bundles. He found collateral circulation from the system of the ascending palatal arteries in the beginning, and from the incisive artery later. After a prolonged period of time, the number and caliber of the collateral vessels increased.

Sgouras (*16*) reported a 1962 survey by Lewin in which more than 50% of the 320 surgeons in the United States and Canada who answered questionnaires were using the Langenbeck Procedure. Slightly less than half were using the V-Y retroposition. The majority of British surgeons use the V-Y with individual modifications. Sgouras himself utilizes V-Y with fracture of the hamalus process and division of the great palatine vessels. He does not believe that gentle and proper surgery on the palate, done by expert plastic surgeons results in arrests of maxillary growth.

Materials and Methods

In this study a total of 222 individuals were examined.

Aarhus Sample: From a total of 85 female individuals with isolated clefts of the palate and 66 normal (non-cleft) females (*3*), two subgroups were selected and matched according to age. Age Group A of 20 CPO and 20 normal individuals and age Group B of 19 CPO and 19 normal individuals. All individuals were operated using the conventional V/W-Y palatoplasty (*10*) with the posterior palatine neurovascular bundles left intact. The total cleft group was operated by one surgeon. The normal sample involved individuals with no apparent facial deformities, selected randomly from the Aarhus school system.

Details on the cleft and normal samples are presented in Table 1.

Bratislava Sample: From a total of 41 individuals with isolated cleft

TABLE 1. Detailed description of the Aarhus and Bratislava normal and cleft samples used in this investigation.

Age subgroup	*Aarhus*				*Bratislava*			
	normal group		*cleft group*		*normal group*		*cleft group*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Sample size	20	19	20	19	10	14	10	14
mean age in years	7.1	13.5	7.0	13.0	7.5	12.1	8.0	12.4
mean age at palatoplasty in years	—	—	2.2	2.4	—	—	2.2	1.9
sex*	F	F	F	F	F, M	F, M	F, M	F, M
cleft type**								
1	—	—	0	0	—	—	0	0
2	—	—	8	3	—	—	3	9
3	—	—	8	14	—	—	3	2
4	—	—	4	2	—	—	4	3

* F = Female; M = Male.
** Cleft Type 1: Bifid uvula and/or soft palate cleft.
Cleft Type 2: Complete soft palate cleft not involving hard palate.
Cleft Type 3: Soft and hard palate cleft not extending to the incisive papilla.
Cleft Type 4: Complete soft and hard palate cleft extending to the incisive papilla.

of the palate and 30 normal (non-cleft) individuals (*2*) two subgroups were selected and matched according to age and sex. Age group A of 10 CPO and 10 normal individuals, and Age group B of 14 CPO and 14 normal individuals. All individuals were operated using the V/W-Y palatoplasty modified by severing the posterior palatine neurovascular bundles (*8*). The cleft group was also operated by one surgeon.

The normal sample was selected from the Bratislava school system as having acceptable dental occlusion and no apparent facial deformity. Details of the cleft and normal samples are presented in Table 1.

All individuals in both the Aarhus and Bratislava samples were Caucasians but to avoid the influence of any ethnic differences on the interpretation of the results, each cleft group was initially compared to its corresponding normal group and the relative differences or changes within each group (Aarhus and Bratislava) were evaluated.

The scope of this investigation will be limited to comparisons of facial skeletal relations as measured from cephalograms, and dental relations as defined by Angle's classification of malocclusion.

Palatoplasty on the Danish (Aarhus) Sample: Fogh-Andersen and Dahl (*10*) in their description of the palatoplasty used, summarized the effect of the cleft in the palate on the method of closure by stating:

> In posterior palatal repair we use the Wardill V-Y or 4-flap procedure depending on the size of the cleft, with fracture of the hamulus, preservation of the

artery, and lateral relaxation incisions far backwards, combined with Ecker's rotation flap from cheek mucosa to cover the lateral defect.[1]

Palatoplasy on the Bratislava Sample: Demjen (*8*) described his palatoplasty by stating:

> Regardless of the extent of the cleft, the oblique incisions of the oral mucoperiosteum are directed obliquely from the posterior edge of the hard palate at the posterior nasal spine to join the posterior end of the lateral incision at the canine tooth. Thus, in a cleft of the soft palate only, one anterior and two posterior flaps are created. This is the three-flap operation, or V-Y procedure. In cases where the cleft reaches the incisive foramen or extends through the alveolus, two anterior and two posterior flaps are created by these oblique incisions. This is the four flap or W-Y procedure.[2]

Then he states:

> The palatine artery grasped in the forceps is put on stretch, thus leading to the greater palatine foramen. The scaler is used to dissect the neurovascular bundle circumferentially.

In his procedure the nasal mucosa is left intact and the lateral pharyngeal walls are mobilized medially by entering the pterygoid space. The hamular process of the pterygoid plate is also fractured.

Cephalometric Techniques and Procedures: Lateral x-ray cephalograms were taken on each individual with the head oriented to Frankfort Horizontal Plane and the teeth in occlusion.

The following points were identified on each lateral x-ray film for use as measurement landmarks (Figure 1): Sella (S), Nasion (N), Subspinale (A), Supramentale (B), Pogonion (Pog), Gnathion (Gn), Menton (Me), Gonion (Go), Pterygomaxillary fissure (PTM), Anterior Nasal Spine (ANS) and Anterior Nasal Spine Prime (ANS′) which is a point on line N-Me located at the intersection of a perpendicular from ANS on N-Me. Further information about landmark definition and location may be found in any of the following references (*5, 12, 13 and 15*). For all bilateral landmarks the midpoint between projections was used where appropriate.

The following angles were measured on each cephalogram: SNA, SNANS, both of which relate points on the maxilla to the anterior cranial base line SN; angles SNB, SNPog and NSGn, all of which relate points on the mandible to SN, and angles NAPog and ANB both of which are descriptive of the skeletal profile since they reflect relationships between profile points on both jaws to the anterior terminus of line SN.

Two additional angles which involve the use of the mandibular plane line designated as MP (Go-Me) were measured. Angle MP:SN which relates the position of the lower border of the mandible relative to the anterior

[1] All palatoplasties were performed in the Deaconness Hospital in Copenhagen. (Professor P. Fogh-Andersen. Chief, Department of Plastic Surgery).

[2] All palatoplasties were performed in Bratislava, C.S.S.R. (Professor S. Demjen. Chief, Plastica Chirurgia).

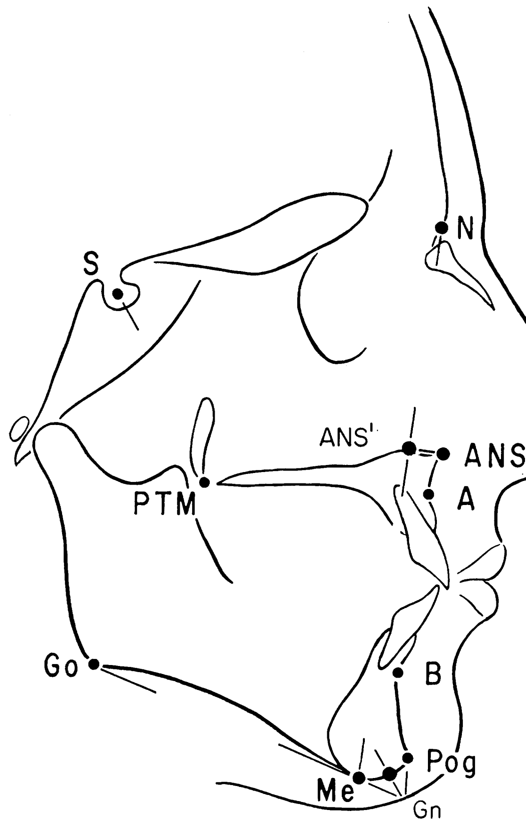

FIGURE 1. Landmarks Used.

cranial base, and angle $\bar{1}$:MP which relates the long axis of the most labially positioned mandibular incisor and the mandibular plane.

The following linear dimensions were measured: ANS-PTM (maxilllary depth); S-N (anterior cranial base depth); N-Me (total face height); and N-ANS′ (upper face height).

Each linear measurement was corrected for magnification. These derivations were performed to facilitate more valid comparisons between linear dimensions, and to aid in future comparisons of data from cephalograms made using different x-ray apparatus.

Four different ratios or indices of craniofacial form were computed using various of the above linear measurement data. Such indices are useful in the identification of possible intergroup differences in shape or form, as assumed from differences in absolute size. They are in addition, unaffected by systematic variation in data resulting from films being made on different x-ray apparatus. The ratios derived were: 1) N-ANS′/N-Me, or upper face height/total face height; 2) ANS-PTM/S-N, or maxillary depth/anterior cranial base depth; 3) N-ANS′/S-N, or upper face height/anterior cranial base depth and 4) S-N/N-Me, or anterior cranial base depth/total face height.

MEASUREMENT TECHNIQUE: The technique for obtaining data on the 10 angular and five linear dimensions was based on methods previously reported (*5*). The technique included: (a) the independent acquisition of double sets of measurements by each of the 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.

From paired t-test comparisons of interinvestigator reliability, the conclusion was that, for the purposes of this study, the obtained levels of measurement technique reliability were more than adequate.

Dental Parameters Examined: The incidence of malocclusion was calculated for both the Aarhus and Bratislava cleft groups. Angle Classification (based on the relationship of the upper and lower permanent 1st molars) was used to classify the different malocclusions. Thus, an individual may be classified as either having a normal occlusion or a Class I, Class II, or Class III malocclusion.

Analysis of Data

Means, standard deviations, and standard error of the mean on the different parameters for each age subgroup in the two samples were obtained. t-tests and F ratios were calculated to test the hypothesis of no differences between the CPO and normal population means and the variability for each of the 17 parameters studied.

As stated before, variation in facial relations and dimensions obtained through direct comparisons between the Aarhus and Bratislava cleft individuals can be attributed to either ethnic or management differences. To eliminate ethnic differences each cleft group (Aarhus and Bratislava) was first compared to a matched normal group from the same population. The derived relative differences within each population were then compared.

Each measurement in the cleft group was made as a percentage of the mean measurement of the corresponding normal group. The mean and standard deviation for these percentage differences were calculated separately at each age subgroup for both the Aarhus and Bratislava samples. t-tests were used to determine whether the percentage differences of both samples were significantly different.

Significance was predetermined at the .05 and .01 levels of confidence.

Results

CEPHALOMETRIC FINDINGS: Tables 2 and 3 contain inter-group comparisons of percentage changes between the Bratislava and Aarhus samples

TABLE 2. Comparisons of percentage differences between the young Aarhus and the young Bratislava groups.

variables	*Aarhus group (CPO % normal) N = 20 matched pairs*			*Bratislava group (CPO % normal) N = 10 matched pairs*			*scores of*	
	$\bar{x}$	*S.D.*	*S.E.*	$\bar{x}$	*S.D.*	*S.E.*	*F-ratio*	*t-tes*
SNA	94.1	4.6	1.0	98.7	4.5	1.4	1.04	−2.56**
SNB	96.4	3.9	0.9	100.5	3.6	1.2	1.15	−2.82**
ANB	61.8	57.4	12.8	63.4	58.2	18.4	1.03	−0.07
SNPog	96.7	4.0	0.9	100.2	3.4	1.1	1.40	−2.31*
SNANS	95.0	4.7	1.0	98.6	4.9	1.5	1.09	−1.96
NAPog	49.9	71.6	16.0	70.2	66.4	21.0	1.16	−0.75
NSGn	103.8	5.2	1.2	99.9	3.2	1.0	2.74	2.13*
MP:SN	114.4	15.5	3.5	110.5	10.2	3.2	2.33	0.72
$\bar{1}$:MP	86.5	8.9	2.0	87.7	4.0	1.2	5.05**	−0.40
N-ANS′	98.7	6.8	1.5	101.1	5.9	1.9	1.31	−0.93
N-Me	101.8	5.2	1.2	100.6	4.0	1.3	1.65	0.64
ANS-PTM	97.0	5.7	1.3	96.8	7.7	2.4	1.83	0.06
S-N	100.2	4.4	1.0	99.8	3.6	1.1	1.52	0.24
N-ANS′/N-Me	96.9	4.7	1.0	100.4	5.3	1.6	1.50	−1.74
ANS-PTM/S-N	97.0	5.1	1.1	100.6	5.7	1.8	1.26	−1.76
S-N/N-Me	96.8	4.4	1.0	97.0	7.2	2.3	2.75	−0.10
N-ANS′/S-N	98.4	4.5	1.0	99.3	4.6	1.4	1.04	−0.51

* $\alpha = .05$.
** $\alpha = .01$.

for the two age subgroups. The parameters in both tables describe antero-posterior and vertical relations of the cranio-facial complex. In each table, the mean ($\bar{x}$) and standard deviation (S.D.) of the percentage difference as well as the standard error of the mean (S.E.) were reported for each group. Scores for the F-ratio (F) and t-tests were also reported in the tables.

Previous comparisons of the CPO and normal individuals in both the Aarhus and Bratislava samples showed many statistically significant differences in both age subgroups. These findings were reported elsewhere (*2, 3*). Since the purpose of this investigation is to compare the relative effect of the two palatoplasties, the reader will be referred to the original papers if interested in the CPO-Normal comparisons within each sample.

In this investigation comparisons of the relative differences between the younger Aarhus and younger Bratislava subgroups (Table 2), indicated that Angles SNA, SNB, SNPog and NSGn were larger in the Bratislava group (P = .01, .01, .05 and .05 respectively). On the other hand, comparisons of relative differences between the Aarhus and Bratislava older age subgroups (Table 3) were not statistically significant on any of the 17 parameters measured.

Dental Findings: Table 4 contains the detailed findings on the incidences of malocclusion in the total Bratislava (N = 41) and the total

TABLE 3. Comparison of percentage differences between the old Aarhus and the old Bratislava groups.

variables	*Aarhus group (CPO % normal) N = 19 matched pairs*			*Bratislava group (CPO % normal) N = 14 matched pairs*			*scores of*	
	x̄	*S.D.*	*S.E.*	*x̄*	*S.D.*	*S.E.*	*F-ratio*	*t-test*
SNA	96.0	5.0	1.1	97.0	2.9	0.8	2.89*	−0.66
SNB	97.6	4.4	1.0	97.2	3.0	0.8	2.08	0.27
ANB	55.3	57.8	13.3	88.2	96.3	25.7	2.77*	−1.22
SNPog	97.0	4.2	1.0	97.4	3.5	0.9	1.45	−0.26
SNANS	96.4	5.3	1.2	98.0	3.2	0.9	2.71	−0.95
NAPog	33.6	115.0	26.4	78.5	200.8	53.7	3.05*	−0.81
NSGn	104.4	5.5	1.3	102.5	4.8	1.3	1.32	1.05
MP:SN	111.6	14.1	3.2	115.3	17.7	4.7	1.57	−0.68
Ī:MP	91.5	7.5	1.7	90.0	7.3	2.0	1.04	0.55
N-ANS′	99.1	9.5	2.2	98.4	5.9	1.6	2.60	0.25
N-Me	100.8	7.3	1.7	98.4	5.1	1.4	2.01	1.02
ANS-PTM	96.7	9.7	2.2	95.1	6.5	1.7	2.22	0.53
S-N	97.0	5.9	1.4	98.2	4.1	1.1	2.09	−0.66
N-ANS′/N-Me	98.6	5.6	1.6	99.7	4.9	1.3	1.85	−0.54
ANS-PTM/S-N	98.5	6.5	1.5	99.9	5.4	1.4	1.45	−0.63
S-N/N-Me	99.7	7.5	1.7	96.6	4.5	1.2	2.82	1.36
N-ANS′/S-N	96.4	5.7	1.3	99.6	5.4	1.4	1.11	−1.65

* $\alpha = .05$.
** $\alpha = .01$.

TABLE 4. Percentage distribution of individuals with normal occlusion, Class I, II and III malocclusion in both the Bratislava and Aarhus cleft samples.

	all ages		*age group A*		*age group B*		*age group C*	
	Bratislava N = 41	*Aarhus N = 85*	*Bratislava N = 16*	*Aarhus N = 34*	*Bratislava N = 25*	*Aarhus N = 29*	*Bratislava*	*Aarhus N = 22*
Normal	20.2	30.6	12.5	30.2	28.0	21.2	—	40.3
Class I	38.8	45.5	37.5	33.3	40.0	65.4	—	37.8
Class II	31.6	16.1	31.2	28.1	32.0	7.1	—	13.1
Class III	9.4	7.8	18.8	8.4	0.0	6.3	—	8.8

Aarhus (N = 85) cleft groups. The discussion will be limited to the incidence of malocclusion in the total group.

The incidence of malocclusion in the Aarhus cleft sample was 69.4% compared to 79.8% in the Bratislava group. Using χ^2 this difference was not found to be statistically significant ($P > .05$).

Of those Bratislava cleft individuals with a malocclusion, 54.3% were

Class I, 35.2% were Class II and 10.5% were Class III, compared to 65.5%, 23.2% and 11.3% for the corresponding Aarhus groups. In general there are more Class I and less Class II malocclusions in the Aarhus cleft groups compared to the Bratislava group.

In Table 5 the percentage incidence and distribution of malocclusion in both the normal and cleft populations are presented. Although the incidence of malocclusion is quite different in the normal Bratislava (49.6%) and the normal Aarhus (78.5%) populations, the percentage distribution of the different classification of malocclusion is much closer. Compared to normals both cleft groups have a tendency for an increase in the incidence of Class III malocclusions; the Bratislava cleft group has a tendency for an increase in the incidence of Class II malocclusions; and finally the Aarhus cleft group has a tendency for an increase in the incidence of Class I malocclusions.

Discussion

Severance of the posterior palatine neuro-vascular bundles is a very controversial issue. The opponents of such a procedure believe that severing the bundle will have a deleterious effect on the growth of the maxilla. The proponents of the procedure on the other hand believe that the blood supply to the palate comes from various sources and therefore this procedure, per se, should have the same effect on facial growth as the otherwise similar but more conservative procedure. The advocates of severance of the bundles also believe that this procedure allows them to move the mucoperiosteal flaps more posteriorly creating a relatively longer palate. This in turn is claimed to result in better speech.

As mentioned before, individuals with isolated clefts of the palate present the best medium to evaluate palatoplasties in particular, for the simple fact that the effect of other variables such as lip cleft and/or surgery are eliminated. It is obvious that there are still other variables which

TABLE 5. Percentage distribution of normal occlusion and malocclusion in the normal and CPO populations.

	Bratislava		*Aarhus*	
	*Normal**	*Cleft*	*Normal***	*Cleft*
Incidence of Malocclusion	*49.6%*	*79.8%*	*78.5%*	*69.4%*
% with Class I	68.7	54.3	71.2	65.5
% with Class II	29.0	35.2	24.5	23.2
% with Class III	2.3	10.5	4.3	11.3

* Andrik (1954) on 2509 Bratislava children 10–15 years old.
** Helm (1968) on 1700 Danish children 6–18 years old.
After Graber (11).

are difficult to quantify, eliminate or account for in any such comparison; e.g., pre- and post-operative care, relative skill of the surgeons, etc.

Regarding the samples used in our cephalometric comparisions certain points need to be mentioned: (a) The Bratislava cleft sample was smaller (N = 24) than the Aarhus cleft sample (N = 39); (b) the Bratislava cleft and normal samples had both female and male individuals. To compensate for this variable the cleft and normal samples in each group were matched for age and sex and the results were reported as percentage change between clefts and normals; and (c) there is a difference of a year between the Aarhus and Bratislava older groups (B). Although such an age difference is remarkably small (considering the problems associated with the collection of data for a project with such a magnitude), it is important to state that 12 vs. 13 years could possibly reflect more than a chronological age difference of one year. In that age-range acceleration of growth does occur in different individuals and this way heighten or obscure some of the differences between the two groups, if any existed.

Cephalometric Facial Relations: Differences in the anteroposterior and vertical facial relations between the cleft group and its corresponding normal group are not solely caused by the palatoplasty but are either mechanically compensatory; i.e., related to the presence of the cleft defect, or are part of a generalized cleft palate syndrome (*1, 2, 3 and 4*). Therefore normal samples are used as a base line from which relative changes are monitored.

The findings in this investigation showed that in the younger age subgroup comparisons (Table 2), four measurements were relatively larger in the Bratislava group; namely SNA, SNB, SNPog and NSGn. In the older age subgroup comparisons (Table 3) no significant differences were found.

These cephalometric findings indicate that in the samples investigated, severing the posterior palatine neurovascular bundles did not have any observable deleterious effects on the cephalometric facial and dental relations measured in this investigation.

Dental Relations: As stated before there is an increased incidence of malocclusion in the Bratislava cleft group, compared to the Aarhus group. This difference was not statistically significant. It should be noted that relatively fewer individuals in the Bratislava cleft sample had the benefit of orthodontic treatment, as compared to the Aarhus group. One interesting fact is the greater percentage of cases with Class II molar relations in the Bratislava group.

Conclusions

The effects of severing the posterior palatine neurovascular bundles were studied in this investigation by comparing two groups of CPO individuals; one group was operated with the conventional W-V/Y, and the other group was operated using the same basic palatoplasty modified by the severance of the posterior palatine neurovascular bundles.

The result of the comparisons of the cephalometric relations between the two cleft groups operated with the different palatoplasties showed few significant differences in the younger age group and no significant differences in the older age group examined.

The incidence of malocclusion in the two groups was not statistically significant.

Acknowledgements: The author would like to acknowledge the aid of Drs. Hughlett Morris, James Schweiger and Duane VanDemark in collecting the cephalometric material from both Bratislava and Aarhus. The author would also like to acknowledge the help extended to him by Dr. William Henderson for the Statistical design of this investigation.

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