Cephalometric Comparisons of the Results of the Wardill-Kilner and Von Langenbeck Palatoplasties

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Two groups of individuals with isolated clefts of the palate were compared. One group had had the Von Langenbeck procedure performed at the University of Iowa and the other the V/W-Y (Wardill-Kilner) procedure performed in Denmark.

All individuals in both groups were Caucasians. In order to avoid the influence of any possible ethnic differences on the interpretation of the results, each cleft group was initially compared to a matched non-cleft group from the same geographical area. Differences were then statistically evaluated using the Student t-test. The incidence of malocclusion in the two operated groups was compared using Chi Square. Different landmarks were pricked on duplicate cephalograms. Nine angular and four linear parameters were measured. Two ratios derived from these linear parameters were also computed.

The results of this study tend to indicate that these two procedures have similar effects upon antero-posterior and vertical growth of the craniofacial complex as determined from cephalometric roentgenograms. While there were no statistically significant differences in the incidence of malocclusion, the need for a detailed study of the effects of different palatoplasties on dental occlusion was emphasized.

Speech results and dental occlusion emerge as critical factors in the evaluation of the effects of these two surgical techniques.

Introduction

An integral part of the overall management of oral clefts is palatal surgery. Thus, many different surgical techniques have been designed and used to repair such defects. Some of these procedures have been discarded; some have been modified; others are still being used. Of the ones still being performed, the Von Langenbeck and the Wardill-Kilner (V/W-Y) palatoplasties seem to be the most popular (Lewin, 1964).

The objective of this investigation is to compare the results of the Von Langenbeck and the V/W-Y (Wardill-Kilner) palatoplasties on facial and dental relationships in females with isolated clefts of the palate (CPO).

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Literature Review

Palmer, et al. (1969), examined 17 individuals with a mean age of 3½ years and with different types of clefts repaired by the Von Langenbeck procedure and 71 cleft children with a mean age of 4½ years whose repairs had been accomplished by the Pushback procedure. They found that the incidence of anterior crossbite and buccal-segment collapse was markedly less in the Von Langenbeck group and that speech results were also better. They concluded that the simpler the surgical technique, the fewer the maxillary deformities. It was their opinion that the Pushback was a more complex surgical procedure requiring more dissection.

Lindsay (1971), comparing the speech results of the two palatoplasties, found that, with the Von Langenbeck procedure, 61% of the cases demonstrated acceptable speech in contrast to 42% of the cases in which a Pushback procedure was performed. Calnan (1971), on the other hand, found that 75% of the cases he operated upon using the Pushback procedure had normal articulation. Ten percent of these had visual nasal escape demonstrated by the clouding of a mirror held beneath the nose.

Jolleys (1954) examined two groups of cleft patients operated upon before two years of age. One group had the Wardill procedure while the second group had the Von Langenbeck operation. He found that the latter were "slightly better" as far as maxillary growth is concerned.

Bishara (1974) compared two groups of individuals with isolated clefts of the palate. One group had had the conventional V/W-Y, and the other group had had the same basic palatoplasty modified by severance of the posterior palatine neurovascular bundles. The results of the cephalometric comparisons between the two groups indicated 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 significantly different.

Kremenak (1970) stripped the mucoperiosteum from the palatal shelves of Beagle dogs to assess growth inhibition. Surgery was performed on the palate unilaterally and included mucoperiosteal flap mobilization, mucoperiosteal denudations of shelf bone, and interruption of blood supply. Variants of this procedure indicated that the critical variable responsible for growth inhibition was denudation of shelf bone and not vascular interference.

The last two investigations emphasize that the critical factor in any palatal surgery is related to the amount and location of the denuded bone.

Grabb (1971) indicates that there are now many accepted operative techniques for the cleft palate patient and that there are no valid data to indicate that one operation or combination of operations is superior to another when speech, facial growth, and hearing are assessed several years after the operation.

Materials and Methods

SUBJECTS. In this study a total of 202 patients were examined. All subjects were Caucasians from Iowa and Denmark. In order to avoid the influence of any ethnic differences, each cleft group (V/W-Y and Von Langenbeck) was initially

compared to its corresponding normal group, and the relative differences within each group were then evaluated.

V/W-Y group: From a total of 56 Danish females with isolated clefts of the palate and 47 non-cleft females, two subgroups were selected and matched on the basis of age. Group A consisted of 34 CPO subjects with a mean age of 7.6 years and 20 normal individuals with a mean age of 7.1 years. Group B was composed of 22 CPO and 27 normal individuals with mean ages of 18.0 years and 16.5 years respectively. All cleft patients had been operated upon by one surgeon using the conventional V/W-Y palatoplasty. The normal subjects had no apparent facial deformities and were selected randomly from the Aarhus (Denmark) school system. Information regarding both the cleft and the normal groups is presented in Table 1.

Von Langenbeck group: From a total of 42 females with isolated clefts of the palate and 57 non-cleft females, two subgroups were also selected and matched on the basis of age. Group A consisted of 28 CPO (mean age 9.8 years) and 32 normal individuals (mean age 8.2 years) and Group B of 14 CPO (mean age 17.5 years) and 25 normal subjects (mean age 19.4 years). All cleft subjects had been operated upon by one surgeon using the Von Langenbeck palatoplasty. The normal sample, selected randomly from Iowa (USA) school children, had acceptable dental occlusion and no apparent facial deformity. Information regarding these subjects is also summarized in Table 1.

In the early years of the Iowa Cleft Palate Center, some of the more severe clefts were obturated. This is reflected in the distribution of the cleft types in the Von Langenbeck group. This bias, if at all significant, would tend to favor the Von Langenbeck group.

SURGICAL PROCEDURES. 1. Wardill-Kilner, V/W-Y or Pushback Palatoplasty: Fogh-Anderson and Dahl (1964) described the surgical techniques used on the Danish cleft group participating in this study by stating:

TABLE 1. Detailed description of the two operated cleft groups (Wardill-Kilner and Von Langenbeck) and their corresponding normal groups.

	Wardill-Kilner				*Von Langenbeck*			
	normal group		*cleft group*		*normal group*		*cleft group*	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*
Sample size	20	27	34	22	32	25	28	14
Mean age in years	7.1	16.5	7.6	18.0	8.2	19.4	9.8	17.5
			6.2–8.7	15.5–23.1	6.9–9.7	18.2–23.4	8.1–10.6	15.0–21.5
Mean age at palatoplasty in years	—	—	2.2	2.1	—	—	3.2	3.6
Cleft type*								
1	—	—	0	0	—	—	0	0
2	—	—	12	5	—	—	11	6
3	—	—	15	14	—	—	14	6
4	—	—	7	3	—	—	3	2

* Cleft Type 1: Bifid Uvula
2: Complete Cleft of the Soft Palate
3: Complete Cleft of the Soft Palate and Part of the Hard Palate
4: Complete Cleft of the Soft Palate and Hard Palates Extending to the Incisive Papilla.

> In posterior palate repair we use the Wardill V-Y and 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. Suture with plain catgut.

Thus the method of palatal repair used on this group is essentially the conventional V/W-Y described by Wardill (1937) and Kilner (1937) who independently devised similar techniques for palatal repair based upon but more radical than the classical Veau (1931) procedure.

2. Von Langenbeck (1961): Lindsay (1971) summarized the original Von Langenbeck palatoplasty as follows:

> 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 stated that Von Langenbeck retained an anterior attachment for the flaps, avoided ligation of the palatine neuro-vascular bundles, and denuded the free border of the nasal septum for attachment of the palatal flap.

The procedure performed on the Iowa group was essentially the same but, in addition, the tendon of the tensor veli palatini was slipped off the hamular process or the process itself was fractured.

PARAMETERS EXAMINED. The scope of this investigation was limited to comparisons of facial skeletal relationships as measured from cephalograms and dental relationships as defined by Angle's classification of malocclusion.

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

Points identified on each lateral x-ray film for use as measurement landmarks are shown in Figure 1 and included 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 on the intersection of a perpendicular from Ans on N-Me. For all bilateral landmarks, the midpoint between projections was used where appropriate. Further information about landmark definition and location may be found in previous publications (Krogman & Sassouni, 1957; Meredith, 1961; Palmer, et al., 1969; Salzman, 1958).

The following angles were measured on each cephalogram: SNA, SNAns, both of which related points on the maxilla to the anterior cranial base line S-N; angles SNB, SNPog and NSGn, all of which relate points on the mandible to S-N; and angles NAPog and ANB, both of which are descriptive of the skeletal profile since they reflect relationships between profile points on both maxilla and mandible to the anterior terminus of line S-N. Two additional angles which involve the use of the mandibular plane line, designated as MP (Go-Me), were also measured. These included angle MP:SN, which relates the position of the lower border of the mandible to the anterior cranial base, and angle $\overline{1}$:MP,

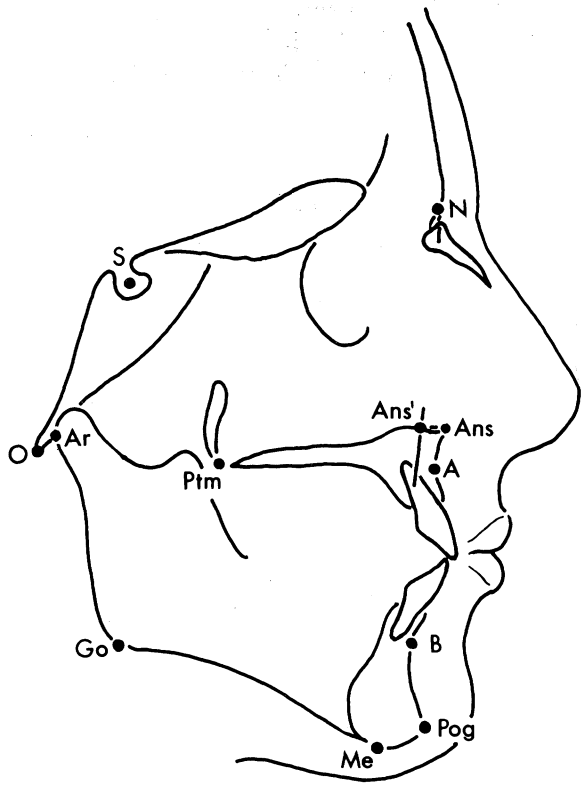

FIGURE 1. Landmarks used.

which relates the long axis of the most labially positioned mandibular incisor to the mandibular plane.

The following linear dimensions were measured: Ans-Ptm (maxillary depth), S-N (anterior cranial base depth), N-Me (total face height), and N-Ans′ (upper face height). All linear dimensions were corrected for magnification.

Ratios or indices of craniofacial form were computed using certain of the linear measurement data. The ratios derived were: 1) N-Ans′/N-Me or upper face height/total face height and 2) Ans-Ptm/S-N or maxillary depth/anterior cranial base depth.

Measurement Technique: The technique for obtaining data on the nine angular and four linear dimensions was based on methods reported elsewhere (Bishara, 1975; Bjork, 1947). The technique included: (a) independent measurements done twice by each of the two investigators; (b) the development of intrajudge agreement by each investigator; (c) the averaging of each investigator's two sets of measurements; and (d) the averaging of the individual measurements to yield the final set of measurements for analysis. The t-test for paired comparisons applied to the averaged measurements of the two investiga-

tors suggested that, for the purposes of this study, the measurements were not significantly different from one another.

Dental Parameters Examined: The incidence of malocclusion was calculated for both the Von Langenbeck and V/W-Y cleft groups. Angle Classification (based on the relationship between the upper and the lower permanent first molars) was used to classify occlusion either normal or as Class I, Class II, or Class III malocclusion.

ANALYSIS OF DATA. Any variations in facial relationships and dimensions obtained from direct comparisons between the Danish and the Iowa cleft subjects can be attributed either to ethnic or to management differences. To eliminate ethnic differences, each cleft group 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 means and standard deviations for these percentage differences were calculated, and t-tests were computed to determine whether the mean differences between samples were statistically significant at either the .05 or .01 levels of confidence.

The incidence of malocclusion in the two groups was also statistically compared using Chi Square. Because of the small number of cases in some of the cells (see Table 3), it was necessary to combine some of the groups for comparative purposes. Thus, for each age group, Chi squares were computed comparing a) the incidence of all malocclusions and b) the incidence of Class II malocclusions in the two surgical groups.

TABLE 2. Comparisons of the percentage differences between Wardill-Kilner and Von Langenbeck Groups A (Young)

	Wardill-Kilner group (CPO % normal)			*Von Langenbeck group (CPO % normal)*			*F-ratio*	*t-test*
	$\bar{x}$	*S.D.*	*S.E.*	$\bar{x}$	*S.D.*	*S.E.*		
SNA	93.8	4.1	0.7	95.9	4.8	0.9	1.39	−1.91
SNB	97.0	3.8	0.6	96.6	5.5	1.0	2.09*	0.40
ANB	48.5	68.2	11.5	78.7	83.6	15.8	1.51	−1.58
SNPog	97.4	3.9	0.6	95.6	4.8	0.9	1.47	1.63
NAPog	32.6	81.3	13.7	109.6	167.2	31.6	4.23**	0.03
NSGn	103.6	5.3	0.9	105.4	5.2	0.9	1.04	−1.37
MP:SN	115.0	15.4	2.6	119.2	15.5	2.9	1.01	−1.07
$\bar{1}$:MP	86.9	7.9	1.3	90.5	7.4	1.4	1.12	−1.86
N-Ans′	100.3	7.9	1.3	94.1	7.7	1.4	1.05	3.10**
N-Me	102.1	5.2	0.8	97.5	5.7	1.0	1.19	3.31**
Ans-Ptm	96.7	5.9	1.0	91.0	5.1	0.9	1.36	4.07**
S-N	99.6	5.1	0.8	94.9	4.2	0.8	1.47	3.92**
$\frac{\text{N-Ans′}}{\text{N-Me}}$	98.3	5.7	0.9	96.6	6.7	1.2	1.37	1.06
$\frac{\text{Ans-Ptm}}{\text{S-N}}$	97.1	5.1	0.8	95.9	5.4	1.0	1.13	0.88

* $p < .01$
** $p < .05$

FINDINGS. *Group A—Young Group Comparisons* (Table 2): Comparisons of Maxillary, Mandibular, Maxillary-Mandibular, and Cephalometric Dental Relationships between the two cleft groups did not reveal any significant differences.

All linear measurements were significantly different between the two groups, but none of the ratios reached significance.

Incidence of Malocclusion (Table 3): Although the incidence of malocclusion was higher in the Von Langenbeck group, Chi Square was not statistically significant at the .05 level of confidence. This was also true for the incidence of Class II malocclusions.

Group B—Old Group Comparisons (Table 4): There were no statistically significant differences between the two groups in maxillary, mandibular,

TABLE 3. Incidence of malocclusion in the two groups examined.

	Age Group A		*Age Group B*	
	Langenbeck N = 24	*Wardill-Kilner N = 34*	*Langenbeck N = 6*	*Wardill-Kilner N = 22*
Normal	% 16.7 (N = 4)	30.6 (N = 10)	16.7 (N = 1)	40.3 (N = 9)
Class I	% 45.8 (N = 11)	45.5 (N = 15)	33.3 (N = 2)	37.8 (N = 8)
Class II	% 33.3 (N = 8)	16.1 (N = 6)	33.3 (N = 2)	13.1 (N = 3)
Class III	% 4.2 (N = 1)	7.8 (N = 3)	16.7 (N = 1)	8.8 (N = 2)

TABLE 4. Comparisons of the percentage differences between the Wardill-Kilner and Von Langenbeck Groups B (Old).

	Wardill-Kilner group (CPO % normal)			*Von Langenbeck group (CPO % normal)*			*F-ratio*	*t-test*
	$\bar{x}$	*S.D.*	*S.E.*	$\bar{x}$	*S.D.*	*S.E.*		
SNA	95.3	4.7	0.8	96.6	7.1	1.9	2.24	−0.71
SNB	98.1	4.2	0.7	98.0	7.8	2.1	3.49**	0.05
ANB	25.8	77.1	13.2	37.9	156.1	41.7	4.10**	−0.28
SNPog	97.9	3.9	0.6	99.1	6.2	1.6	2.55*	−0.66
NAPog	−40.4	162.5	27.8	169.3	561.8	150.1	11.94**	−1.37
NSGn	102.2	4.9	0.8	101.9	6.4	1.7	1.67	0.21
MP:SN	108.3	13.9	2.3	110.6	21.9	5.8	2.47*	−0.37
$\overline{1}$:MP	88.2	8.7	1.4	91.5	9.0	2.4	1.07	−1.16
N-Ans'	96.5	8.8	1.5	101.3	6.3	1.7	1.91	−1.84
N-Me	97.3	7.5	1.3	101.9	5.7	1.5	1.73	−2.02*
Ans-Ptm	94.9	8.7	1.5	90.9	6.4	1.7	1.87	1.54
S-N	96.1	5.6	0.9	99.3	5.1	1.3	1.22	−1.81
$\frac{\text{N-Ans'}}{\text{N-Me}}$	99.3	5.9	1.0	99.5	6.4	1.7	1.20	−0.10
$\frac{\text{Ans-Ptm}}{\text{S-N}}$	98.7	7.0	1.2	91.7	8.1	2.1	1.32	2.96**

* $p < .01$
** $p < .05$

TABLE 5. Measurement Data on the Wardill-Kilner and Von Langenbeck Groups and Their Corresponding Normals.

Parameters Measured	*Wardill-Kilner*				*Danish Sample*				*Von Langenbeck*				*Iowa Sample*			
	Cleft				*Normal*				*Cleft*				*Normal*			
	Group A		*Group B*		*Group A*		*Group B*		*Group A*		*Group B*		*Group A*		*Group B*	
	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*	$\bar{x}$	*S.D.*
SNA	76.6	3.4	79.2	3.7	81.6	3.8	80.7	4.0	77.7	3.9	76.8	5.7	81.0	4.0	79.5	3.3
SNB	74.0	2.9	78.5	3.4	76.2	3.6	77.7	4.3	75.4	4.3	76.1	6.1	78.0	2.7	77.6	3.1
ANB	2.6	3.6	0.7	2.6	5.3	2.2	3.0	2.5	2.4	2.5	0.7	2.9	3.0	1.9	2.0	2.5
SNPog	74.9	3.0	80.7	3.3	76.9	3.9	79.0	4.3	75.9	3.8	78.2	4.9	79.4	2.8	78.9	3.2
NAPog	3.2	8.0	−3.9	6.5	9.9	5.4	3.5	5.4	3.8	5.8	−2.9	7.6	3.5	4.5	1.4	6.3
NSGn	70.5	3.6	67.2	3.9	68.0	3.8	67.5	4.5	69.8	4.0	69.7	3.8	66.2	2.5	67.8	3.4
MP:SN	39.8	5.4	34.1	6.7	34.6	5.2	33.0	6.2	39.0	5.0	36.0	7.1	32.7	4.2	32.6	5.9
$\bar{1}$:MP	83.5	7.6	82.9	6.9	96.1	4.7	93.7	7.4	84.6	6.9	85.3	8.3	93.4	6.2	93.2	8.6
N-Ans′	41.2	3.2	48.2	2.8	41.0	2.2	47.9	2.6	42.6	3.5	47.6	2.9	45.3	2.9	47.0	2.2
N-Me	97.3	5.0	110.0	6.9	95.3	4.4	108.9	5.8	99.8	5.8	110.1	6.2	102.3	4.5	108.0	6.0
Ans-Ptm	44.2	2.7	47.6	3.1	45.7	2.6	50.2	3.2	44.8	2.5	46.2	3.2	49.3	2.1	50.8	3.3
S-N	60.3	3.1	64.9	3.5	60.5	2.4	66.2	3.1	37.0	2.6	37.6	2.9	39.6	2.9	38.5	2.2
$\frac{\text{N-Ans}'}{\text{N-Me}}$	42.3	2.5	43.9	2.5	43.0	1.8	44.0	2.0	42.8	2.9	43.3	2.8	44.3	2.1	43.5	2.2
$\frac{\text{Ans-Ptm}}{\text{S-N}}$	73.4	3.9	73.5	4.7	75.6	3.9	75.9	4.6	73.4	4.1	71.3	6.3	76.5	4.1	77.7	4.6

maxillary-mandibular, and dental cephalometric relationships. The two exceptions were total face height (N-Me) which was relatively larger in the Von Langenbeck group ($p \leqq .05$) and the ratio Ans-Ptm/S-N which was significantly smaller in the Von Langenbeck group ($p \leqq .01$).

Incidence of Malocclusion (Table 3): The number of cases in the Von Langenbeck group on whom complete dental information was available was rather limited ($n = 6$). Therefore, any generalizations from these findings should be guarded.

The incidence of malocclusion had a tendency to be higher in the Von Langenbeck group, but differences were not statistically significant at the .05 level of confidence.

Table 5 summarizes measurement information on the eight subgroups examined in this investigation.

Discussion

In previous investigations, comparisons between individuals with isolated clefts of the palate and normals have indicated many statistically significant differences. Whether such differences are the result of surgical management is a matter of speculation, and there is some evidence that many of the existing differences are present in both unoperated and operated individuals with isolated clefts of the palate (Bishara, 1975).

The question then remains as to which of several surgical procedures yields the best results in terms of the growth of the craniofacial skeleton. Previous studies comparing the Von Langenbeck and the Wardill-Kilner palatoplasties have arrived at conflicting conclusions.

In this study, an attempt was made to compare the effects of the two procedures at two stages of development, approximately five and fifteen years after surgery. At the later age, most of the potential growth of the craniofacial complex has been completed. Therefore, comparisons become more meaningful since they evaluate the "end product" of facial growth. The significant differences in the linear dimensions found between the two young groups (Groups A) could be attributed to the more than two years difference in the mean ages of the children. This is substantiated by the failure to find differences in the ratios derived from these same linear dimensions (Table 2).

The result of this study, as well as of a previous study (Bishara, 1974) comparing two modifications of the Wardill-Kilner palatoplasty, strongly suggest that the palatoplasties which are most widely used nowadays compare favorably with each other in regard to craniofacial growth in both the anteroposterior and vertical directions.

More work is necessary on a larger sample to determine possible differences in the two palatoplasties in relationship to dental occlusion. Such a study should be performed if possible on individuals who have not had orthodontic treatment.

A crucial issue which enters into the evaluation of the results of any palatoplasty is its effect on speech. A preliminary report (Krause, et al., 1975) on 267 subjects, 149 of whom had had a Von Langenbeck palatoplasty and 118 the

V-Y pushback procedure, indicated that the V-Y pushback procedure was significantly more successful than the Von Langenbeck when all cleft types were combined ($p \leq .01$), in the combined bilateral and unilateral cleft lip and palate group ($p \leq .05$), and in the hard and soft palate only group ($p \leq .05$). There was a trend for the Von Langenbeck to be somewhat more successful in the soft palate only group (92.3% competence) than the V-Y pushback (81% competence) although this difference was not statistically significant. Most of the individuals examined in the latter group were included in the present investigation.

Conclusions

The results of this study tend to indicate that the two palatoplasties studied have a similar effect on the antero posterior and vertical growth of the craniofacial complex as determined from cephalometric roentgenograms. There were also no statistically significant differences in the incidence of malocclusion, but the need for a more detailed study of the effects of different palatoplasties on dental occlusion is indicated.

This and a previous study (Bishara, 1975) tend to indicate that the different palatoplasties investigated do not produce significantly different results in antero-posterior and vertical skeletal and dental relationships as examined from lateral cephalograms. Speech results and the details of dental occlusion become more critical factors in the evaluation of the effects of these palatoplasties.

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