Arch Form and the Deciduous Occlusion in Complete Unilateral Clefts

SAMUEL PRUZANSKY, D.D.S.
HOWARD ADUSS, D.D.S.
Chicago, Illinois

This investigation was designed to answer two fundamental questions pertinent to the current interest in pre-surgical maxillary orthopedics and primary bone grafting in infants with cleft lip and palate. Given a population of complete unilateral clefts of the lip and palate: a) What is the prevalence of maxillary collapse in cases not subject to pre-surgical orthopedics and bone grafting, but entailing conventional repair of the lip and palate? and b) What is the ultimate effect on the complete deciduous occlusion, as measured in terms of crossbite?

Material and Methods

Thirty-three cases of complete unilateral cleft lip and palate were chosen from the longitudinal growth study at the University of Illinois. Selection of cases was based on the following criteria: a) Complete cleft of the lip. Cases which showed slight bridging of soft tissue at the base of the nose or even Simonart's bands across the cleft were rejected. b) Complete cleft of the secondary palate with the vomer completely attached to the opposite maxillary shelf. c) The availability of good quality serial casts (obtained from alginate impressions) beginning prior to lip repair, following lip repair, prior to and following palatal surgery, and articulated casts of the complete deciduous dentition.

On the basis of these restrictions, 337 casts were analyzed. The distribution of the sample according to sex and affected side is shown in Table 1.

Ages at lip repair ranged from three weeks to seven months, with the greatest number between seven and nine weeks. Palatal repair was completed in 28 of the 33 cases before three years of age, and in the remaining cases before five years. The sample represented the operative experience of 17 surgeons (Table 2). Four were members of the faculty and eight were residents at the University of Illinois. The remaining five surgeons, who were not members of that staff, performed both the lip

Drs. Pruzansky and Aduss are affiliated with the Cleft Palate Center, University of Illinois, Chicago, Illinois. This research was supported by research grant PHS D-1064, National Institute of Dental Research.
This paper was presented at the 1964 Convention of the American Cleft Palate Association, Los Angeles, California.

TABLE 1. Distribution of complete unilateral cleft lip and palate sample according to sex and affected side.

	Right	Left	Total
MALES	11	15	26
FEMALES	2	5	7
TOTAL	13	20	33

and palate repair on each patient. The procedures on the lip included variations of the Tennyson and LeMesurier techniques. Palatal repairs included modifications of the Wardill push-back, von Langenbeck, and in a few, incorporation of the vomer flap.

The maxillary casts of each series were examined to determine the relation of alveolar segments prior to lip repair, the spatial configuration of the palatal segments following lip repair, and the effect of palatal repair on arch form.

The occluded casts of the complete deciduous dentition were inspected for the prevalence and type of crossbite occlusion.

Results

VARIATION PRIOR TO LIP REPAIR. Examination of the preoperative maxillary casts revealed varying degrees of separation between the cleft segments (Figure 1). Measurement of the shortest distance between the segments at the level of the alveolus ranged from 1.5 to 15.7 mm in thirty-two cases (Table 3). In one case, overlapping contact of the alveolar segments existed prior to lip repair.

EFFECT OF LIP REPAIR. In all cases, the effect of lip repair was to produce coaptation of the palatal segments with narrowing of the palatal cleft throughout its anteroposterior length. Similarly, the alveolar cleft was reduced in size by this approximation but with sufficient variation to permit categorization of the sample into three groups (Figure 2). Group A (14 cases, 42.4%) shows approximation of the alveolar segments into an end-to-end contact producing a symmetrical arch form.

TABLE 2. Description of surgical procedures and surgeons who performed the techniques.

Surgeons	Cheiloplasty	Palatoplasty
University of Illinois Staff (4)	10	14
University of Illinois Residents (8)	8	4
Senior Surgeons not Affiliated with University of Illinois (5)	15	15

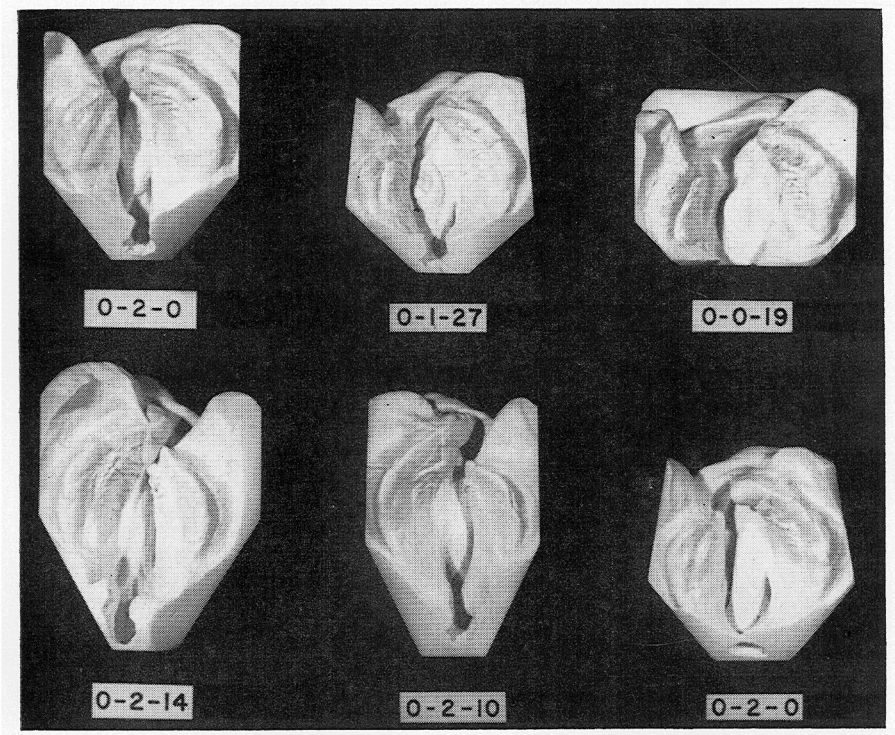

FIGURE 1. Varieties of unoperated complete unilateral clefts of the lip and palate. By classification and general description, these clefts are identical. Clinically significant differences are apparent, however, in the width of the cleft and in the spatial relationship of the palatal processes. (From Pruzansky, S., *Amer. J. Orthod.*, *39*, 601–606, 1953.)

Group B (13 cases, 39.5%) shows an overlap of the segments—the 'collapsed arch' form. Group C (6 cases, 18.1%) shows approximation of the alveolar segments but without contact.

ORIGINAL WIDTH OF ALVEOLAR CLEFT AND ARCH FORM. By tabulating the series in order of increasing width of the alveolar cleft, it was demonstrated that the original width did not correlate with the final relation of the segments following cheiloplasty (Table 3). In other words, cases which appeared morphologically similar in terms of type and width of cleft, behaved differently after similar operative procedures.

CHANGES WITHIN GROUPS. Maxillary configuration at the level of the alveolar processes, recorded shortly after lip repair, was observed to alter in some cases as time progressed. Three of the cases in Group A developed overlap of alveolar segments prior to palatal repair (Table 4).

EFFECT OF PALATOPLASTY ON ARCH FORM. Following palatoplasty, the sample divided itself into two groups, approximation with symmetrical arch

TABLE 3. Relation between the width of the alveolar cleft and maxillary arch form following cheiloplasty (33 cases, complete unilateral cleft lip and palate).

Case No.	Prior To Cheiloplasty		Following Cheiloplasty		
	Width of Alveolar Cleft in m.m.	Age at Initial Record (Yrs-Mos-Days)	Approximation With Contact	Overlap	Approximation Without Contact
205	0.0	0-2-14		x	
851	1.5	0-4-9	x		
119	2.3	0-2-4	x		
335	2.4	0-2-10		x	
308	3.4	0-2-8		x	
86	3.7	0-1-12		x	
595	3.9	0-1-6		x	
644	4.2	0-4-15	x		
241	4.3	0-1-30	x		
647	4.5	0-1-10		x	
738	4.5	0-3-28		x	
245	4.6	0-7-5	x		
232	5.1	0-3-2			x
238	5.3	0-0-22	x		
48	5.5	0-6-17	x		
236	5.6	0-0-30	x		
419	5.9	0-1-4	x		
364	6.2	0-9-12		x	
763	6.6	0-5-1	x		
416	7.0	0-1-0		x	
420	7.9	0-1-0	x		
475	8.4	0-2-17		x	
453	8.8	0-0-10	x		
380	8.9	0-1-28			x
264	9.5	0-1-10	x		
195	10.1	0-0-18	x		
200	10.5	0-1-27			x
439	10.5	0-1-2			x
651	10.9	0-1-14		x	
256	11.4	0-0-22			x
146	12.3	0-1-4		x	
52	15.7	0-1-0			x
111	15.7	0-0-9		x	

form as in Group A and overlap with varying degrees of asymmetry as in Group B (Table 4).

THE COMPLETE DECIDUOUS OCCLUSION. One third of the total sample presented no crossbite whatsoever.

In the remainder, the canine crossbite only was more prevalent than the complete unilateral buccal crossbite. By combining the buccal crossbite group and the anterior and buccal crossbite group, crossbite related to collapse of the arch was noted in only 30 percent of the sample (Table 5).

Discussion

The sample size in this study may seem small to those accustomed to reporting on large series of clinical cases. However, it was essential to select a homogenous sample. The exclusion of subjects with incomplete cleft lips and incomplete cleft palates was required since the prevalence of maxillary collapse would probably be reduced in such cases. The 33 cases selected were chosen from over 100 cases of complete unilateral cleft lip and palate. The remainder were rejected because of the incompleteness of the series. As these cases mature, our sample size will

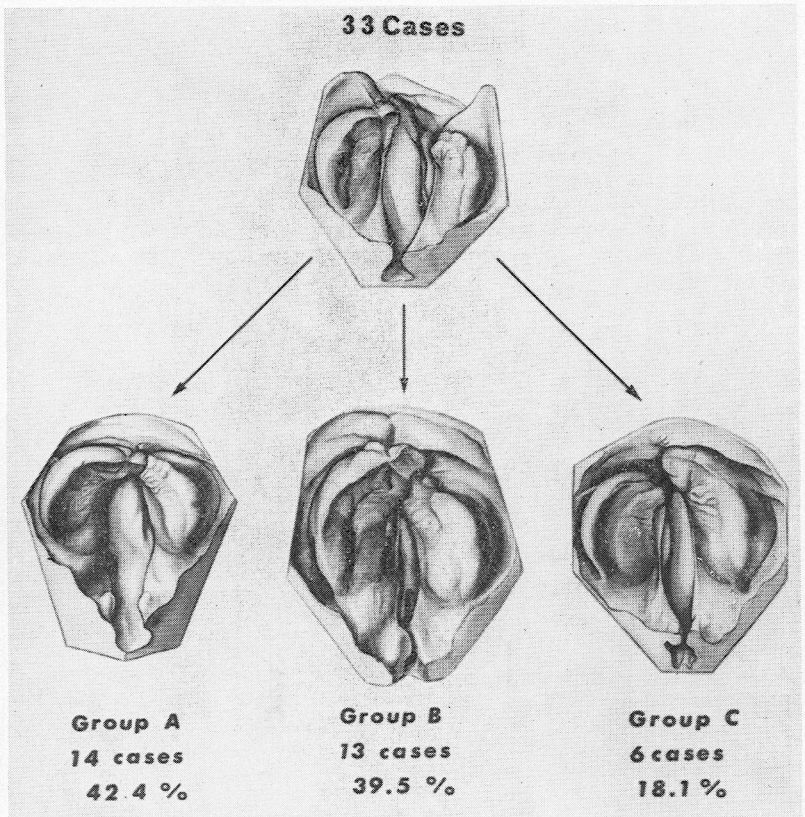

FIGURE 2. Variation in arch form following cheiloplasty: Group A, approximation of the alveolar segments into an end to end contact; Group B, overlap of the segments; and Group C, approximation of the alveolar segments without contact.

increase and permit re-evaluation of these findings on a larger population.

The finding that the original width of the alveolar cleft was not related to final arch form following lip repair, is worthy of special note. It was tempting to reason that the wider the alveolar cleft, the greater the amount of undermining required to repair the lip. Therefore, the greater the tension across the mid-line, and hence a greater incidence of maxillary collapse would follow. Unfortunately, this tidy a priori reasoning was not supported by the results of this investigation (Table 3).

The findings to date are sufficiently conclusive to warrant unequivocal answers to the questions posed at the outset. In cases not subject to pre-surgical orthopedics and primary bone grafting, maxillary collapse prior to palatal repair was found in only 39.5% (13 out of 33 cases). Assuming universal success for the preventive measures so enthusiastically championed here and abroad, prevention of maxillary collapse will

TABLE 4. Relation of alveolar segments in complete unilateral cleft lip and palate (33 cases).

Case No.	Prior To Lip Repair	After Lip Repair			After Palatal Repair		Prevalence and Type of Crossbite Occlusion Complete Deciduous Dentition						
	Width of Alveolar Cleft in m.m.	Approximation With Contact Group A	Overlap Group B	Approximation Without Contact Group C	Approximation With Contact	Overlap	None	Canine Only	Buccal	Anterior and Buccal	Anterior and Canine	Anterior	Maxillary Arch Wider Than Mandibular
48	5.5	x			x						x		
52	15.7			x		x			x				
86	3.7		x			x		x					
111	15.7		x		x					x			
119	2.3	x			x		x						
146	12.3	(x) →	x			x					x		
195	10.1	x			x		x						
200	10.5			x	x			x					
205	0.0		x			x		x					
232	5.1			x	x		x						
236	5.6	x			x			x					
238	5.3	x			x		x						
241	4.3	x			x								x
245	4.6	x				x						x	
256	11.4			x		x				x			
264	9.5	x			x		x						
308	3.4		x			x	x						
335	2.4		x			x			x				
364	6.2	(x) →	x			x	x						
380	8.9			x		x	x						
416	7.0	(x) →	x			x		x					
419	5.9	x			x		x						
420	7.9	x			x				x				
439	10.5			x		x				x			
453	8.8	x			x		x						
475	8.4		x			x			x				
595	3.9		x			x			x				
644	4.2	x			x			x					
647	4.5		x			x		x					
651	10.9		x			x		x					
738	4.5		x			x			x				
763	6.6	x			x				x				
851	1.5	x			x		x						
Total		14	13	6	16	17	11	8	7	3	2	1	1

(x) - overlap prior to palatal repair

TABLE 5. Relation of alveolar arch form to the complete deciduous occlusion: prevalence and type of crossbite.

		CROSSBITE						
	No Crossbite	Canine Only	Buccal	Anterior and Buccal	Anterior and Canine	Anterior	Maxillary Arch Wider Than Mandibular	Total
Approximation With Contact	8	3	2	1	1	-	1	16
Overlap	3	5	5	2	1	1	-	17
Total (n=33)	11 (33.3%)	8 (24.2%)	7 (21.2%)	3 (9.0%)	2 (6.1%)	1 (3.1%)	1 (3.1%)	33 (100%)

be achieved for less than half the cases, since in 60% it would never have occurred (Figure 2).

The figures relating to crossbite in our population are even more revealing and further diminish the claims of prevention through pre-surgical orthopedics and bone grafting. One third of our cases demonstrated no crossbite whatsoever. In eight cases, the crossbite was limited to the canine only. Total unilateral crossbite combined with anterior and buccal crossbite was found in only 13 cases, or 30.2% of the entire sample. Therefore, the best that pre-surgical orthopedics and bone grafting could achieve is the elimination of the 30.2% cited above (Table 5).

It should be noted that in a noncleft population of 564 children in this age range, approximately two percent exhibited anterior crossbite compared with three percent in our cleft sample (*1*). This may suggest that the finding of anterior crossbite in our cleft sample is not significantly different than that found in noncleft children.

In the same population of noncleft children cited above, five percent demonstrated buccal crossbites compared with 30.2% in our cleft sample.

The thesis that crossbite is a manifestation of growth arrest is not supported by the data in our collection. Even in those cases in which complete buccal crossbite was recorded, this was the result of medial and upward displacement of palatal segments rather than arrested growth.

The scars of mutilated arch form resulting from now-abandoned surgical practices, and which formed the basis for Graber's critical reports (*2–4*) on the cleft palate deformity, are no longer evident in the younger generation. Like the scar of the mastoid operation, diphtheria and smallpox, the mutilated palate is now becoming a medical curiosity.

The question may be raised, why was the complete deciduous dentition chosen as the end-point for evaluation of arch form and occlusal disharmony? There are at least two good reasons for selection of this age group as a logical end-point for the present analysis. First, it is a critical period of speech acquisition in the formative pre-school years.

Secondly, utilizing the noncleft population as an index, malocclusion tends to become more prevalent in the mixed and permanent dentitions.

Consequently, the overlay of factors that produce malocclusion in the general population would serve to confound the analysis of cause and effect relationships in the cleft palate population. Our purpose was to study the immediate effects of lip and palate repair and this could best be done at this stage of dental development.

Whatever the limitations one may find in the present report, it does constitute the only control study to date against which the claims for pre-surgical maxillary orthopedics and bone grafting can be assessed.

Summary

Thirty-three cases of complete unilateral cleft lip and palate, possessing good quality casts prior to lip repair, following lip repair, prior to palatal surgery, and into the development of the complete deciduous occlusion, were analyzed with respect to arch form and prevalence of crossbite occlusion. None of the cases were treated by pre-surgical maxillary orthopedics and primary bone grafting.

Collapse of the arch following cheiloplasty, as evident by overlapping of the maxillary alveolar processes in the region of the alveolar cleft, occurred in 13 out of 33 cases (39.5%). No such collapse was noted in the remainder of the sample.

No correlation could be established between the original width of the alveolar cleft and the change in arch form following cheiloplasty.

In 11 of 33 cases, no crossbite was noted. Canine only crossbite was recorded in 8 cases; complete buccal crossbite in 7 cases; anterior and buccal crossbite in 3 cases; anterior and canine crossbite in 2 cases; and anterior crossbite only in 1 case. In one instance, the maxillary arch remained wider than the mandibular.

The present report serves as the only available control data against which the present claims for pre-surgical maxillary orthopedics and primary bone grafting can be assessed.

The Cleft Palate Center
University of Illinois
Chicago, Illinois

Acknowledgement: The authors gratefully acknowledge the invaluable assistance of Mrs. Eunice Levander, R. N., in the accumulation of the data which form the basis of this report.

References

1. *Burlington Orthodontic Research Centre Progress Report No. 5.* Toronto, Canada: University of Toronto Press, p. 65, 1959–1960.
2. GRABER, T. M., and MERRIFIELD, F. W., An appraisal of the developmental deformities in cleft-palate and cleft-lip individuals. *Quart. Bull.*, Northwestern Univ. Med. School, *23*, 1–17, 1949.
3. GRABER, T. M., The congenital cleft palate deformity. *J. Amer. dent. Assoc.*, *48*, 375–395, 1954.
4. GRABER, T. M., Craniofacial morphology in cleft palate and cleft lip deformities. *Surg. Gyn. Obst.*, *88*, 359–369, 1949.