Occlusion and Dental Profile with Complete Bilateral Cleft Lip and Palate

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Bilateral complete cleft lip and palate has persisted as the most difficult type of cleft to habilitate. Maxillary hypoplasia, collapse of the maxillary buccal segments with subsequent buccal crossbite, and persistence of premaxillary protrusion with resultant distortion of facial profile have been cited as major complications. The prevalence and severity of these complications, however, have never been studied systematically. A variety of surgical and orthopedic procedures have been advocated for the affected infant which propose to correct or prevent the occurrence of sequelae heretofore defined inadequately.

The purpose of this report is to document several aspects of dental occlusion in a group of twenty-six patients with bilateral complete cleft lip and palate following repair of the lip and palate. In these patients neither presurgical orthopedics and bone grafting, nor primary resection and setback of the premaxilla were part of the surgical regime. The parameters of occlusion analyzed included anteroposterior molar relation, incidence of buccal crossbite, incisor overjet, incisor overbite, and inclination of the maxillary incisors. These measures reflect beyond the dentition to the encompassing skeleton and ultimately to the facial profile.

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Recording the incidence and severity of the malocclusion for this group could help define the relevant problems and emphasize areas for improvement in reconstructive techniques. The data recorded could also establish a base line and, so to speak, an actuarial table with which to compare the efficacy of diverse treatment procedures.

SAMPLE

Twenty-six patients (twenty males and six females) with bilateral complete cleft lip and palate were chosen from the longitudinal growth study at the Cleft Palate Center of the University of Illinois. Selection of cases was based on the following criteria: a) complete cleft of the lip, alveolar process, and secondary palate, and b) the availability of serial casts and roentgencephalometric films beginning prior to surgical intervention and extending at least until the complete deciduous dentition.

The surgical histories of the sample are summarized in Table I. In eighteen out of the twenty-six cases the lip was repaired in one stage; two-stage lip repair was performed on the remaining eight cases. The cleft in the hard palate was repaired either in one operation or surgery of the soft palate preceded reconstruction of the hard palate.

Presurgical orthopedics or bone grafting of the premaxilla was not part of the surgical regime. At the time of this study the palates of four patients were either unrepaired or records were not available that postdated palatal repair. The premaxillae in six of twenty-

TABLE I

Operation	Initial Lip Surgery*	Initial Palate Surgery**	No Palatal Surgery	Premaxillary Set-Back or Excision
Number	26	22	4	6
Mean Age Yrs.-Mos.-Days	0- 3-25	2-11-55	—	4- 3-27
Range Yrs.-Mos.-Days	0- 0-14 to 0-10-12	0-10-17 to 7- 0- 0	—	1- 7-22 to 6- 2- 4

* In 18 cases the lip was repaired in one stage. In 8 cases the lip was repaired in two stages. The mean age for the second procedure was 5 months, 28 days (range 0-3-14 to 0-9-0).

** In 14 cases the soft and hard palates were repaired in one stage. In 8 cases repair of the soft palate preceded repair of the hard palate. The mean age for the second procedure was 4 years, 11 months, 3 days (range 3-7-11 to 6-1-7).

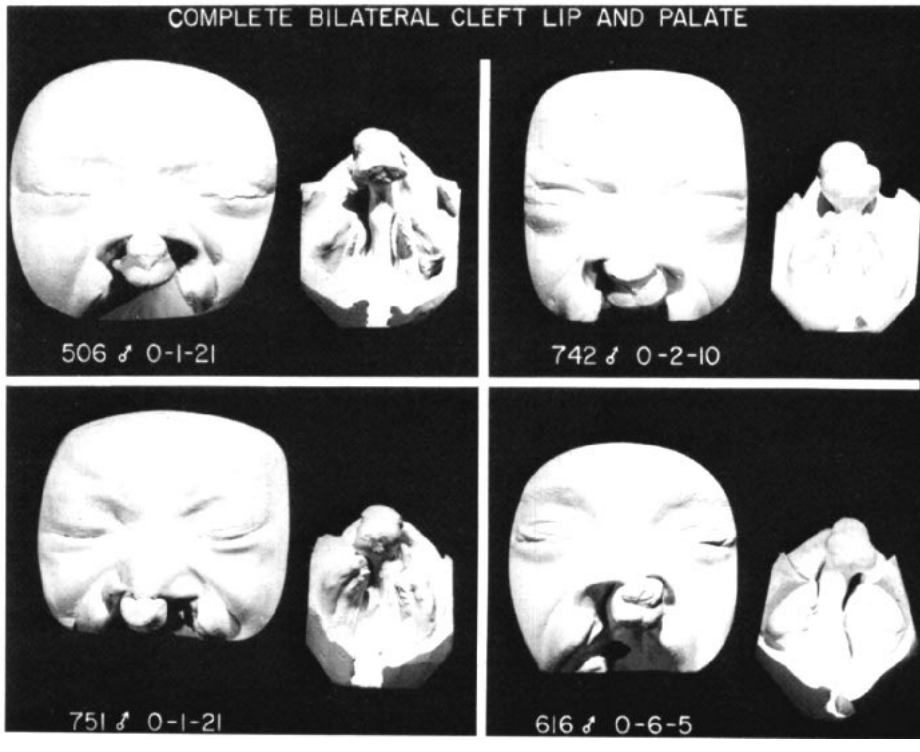


Fig. 1 Face masks and palatal impressions of four infants demonstrating completeness of the bilateral cleft of the lip, alveolar process and palate.

six patients were judged to be so protuberant and disfiguring by the surgeons in charge that secondary procedures were undertaken in the preschool period involving resection and setback of the premaxillae in four cases and total excision in two.

Materials and Methods

Dental casts and roentgencephalometric films utilized in this report were selected from the longitudinal growth study records from the Cleft Palate Center of the University of Illinois. In all instances presurgical records were available to verify the complete bilateral cleft deformity (Figure 1). This report is primarily concerned with the analysis of the dental casts and lateral roentgencephalograms obtained at a time when the deciduous dentition was complete. The records selected for study were generally obtained closest to the patient's fourth birthday. The mean age at which the cephalograms were obtained and analyzed was four years, one month with a standard deviation of± six months. The dental casts selected for analysis were obtained at the same age as the cephalograms, except in six instances where subsequent models were selected in order to use records that postdated palatal closure. The mean age at which the models were obtained and analyzed was four years, five months with a standard deviation of ± one year, three months.

The protocol for analysis of the dental occlusion was as follows:

Anteroposterior Molar Relation: Recorded from articulated study models according to the Angle classification.

Buccal Occlusion: Recorded from articulated study models as presence or absence of crossbite of the individual maxillary teeth (Figure 2).

Interdental Width: Measured as the distance to the nearest tenth of a millimeter between the right and left mesiolingual cusp tips of the deciduous molars and the cusp tips of the canines. These values were then related to the normal distribution of interdental widths for noncleft children of the same sex and age established by Moorrees.[2] The interdental width for cleft population was reported as the standard score computed with reference to the norms for each age and sex. This procedure allows for comparison of interdental widths of diverse age and sex despite the fact that such measurements as age and sex are dependent variables. The formula used for computation of standard scores is as follows:

$$\text{Standard Score} = \frac{\text{Measurement - Mean}}{\text{Standard Deviation}}$$

Incisor overjet: Determined from a tracing of the lateral cephalometric film orientated on a millimeter grid so that nasion (N) was 6° above the horizontal plane relative to sella (S). Overjet was defined with regard to the number of vertical millimeter grid lines between the most labial points of the surfaces of the crowns of the mandibular and maxillary central incisor (Figure 3).

Overbite: Determined from a tracing of the lateral cephalometric film, orientated as above. The overbite was defined as the number of horizontal grid lines between the tip of the maxillary central incisors and mandibular central incisors (Figure 3).

Inclination of the maxillary central incisors: Determined by the angle formed by extending a line through the root of the incisor to the sella-nasion plane (Figure 4).

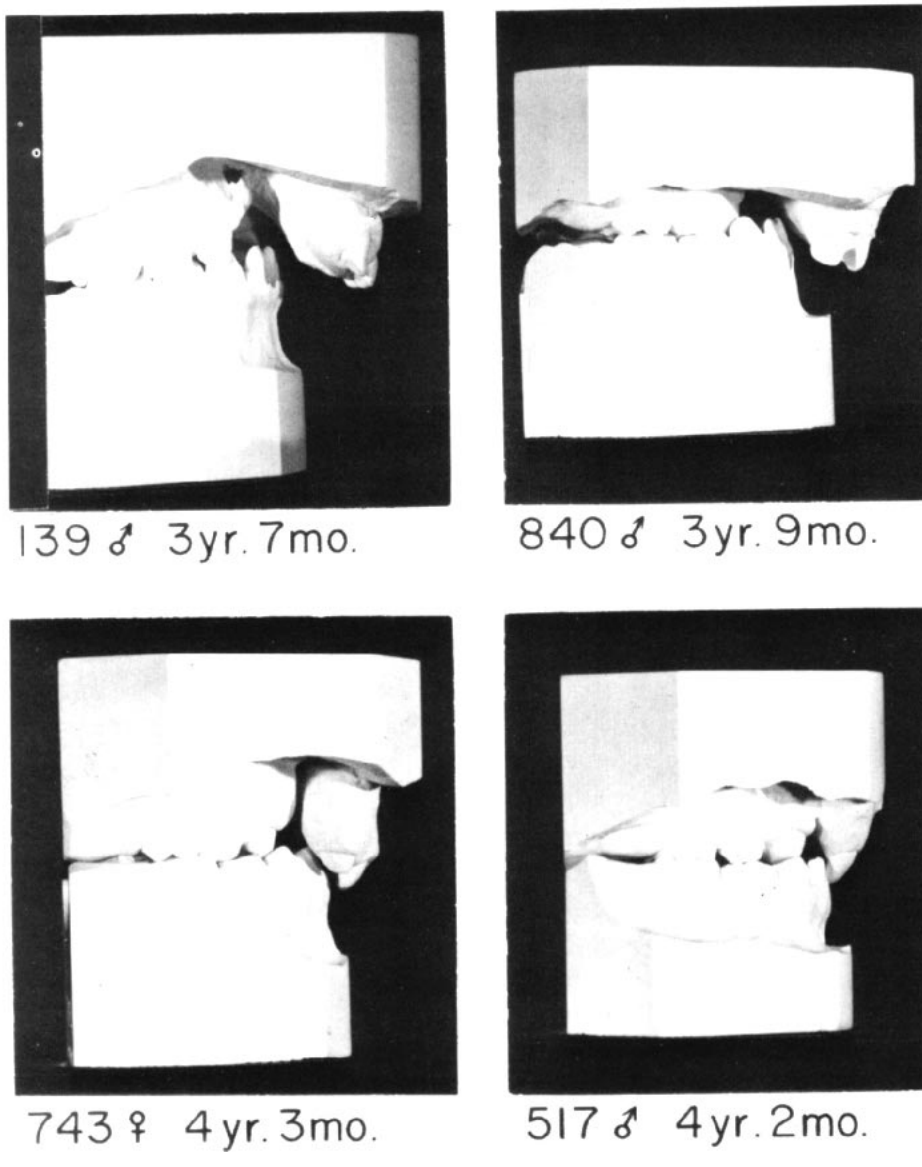
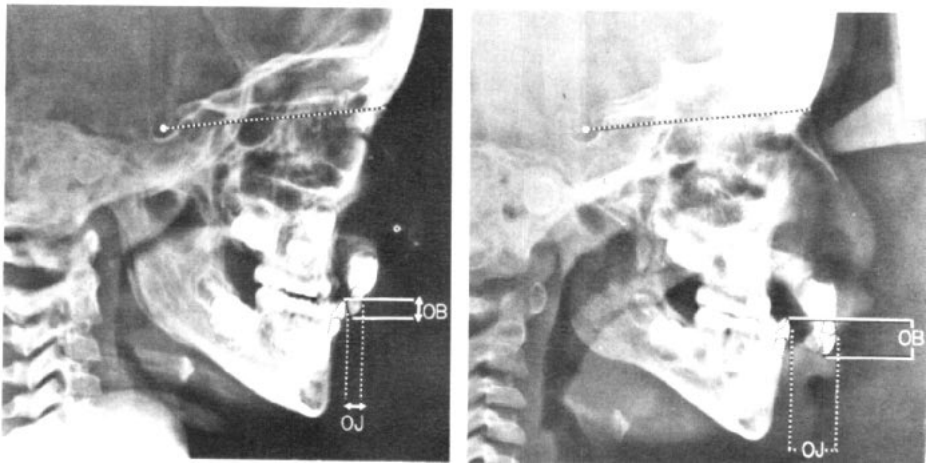


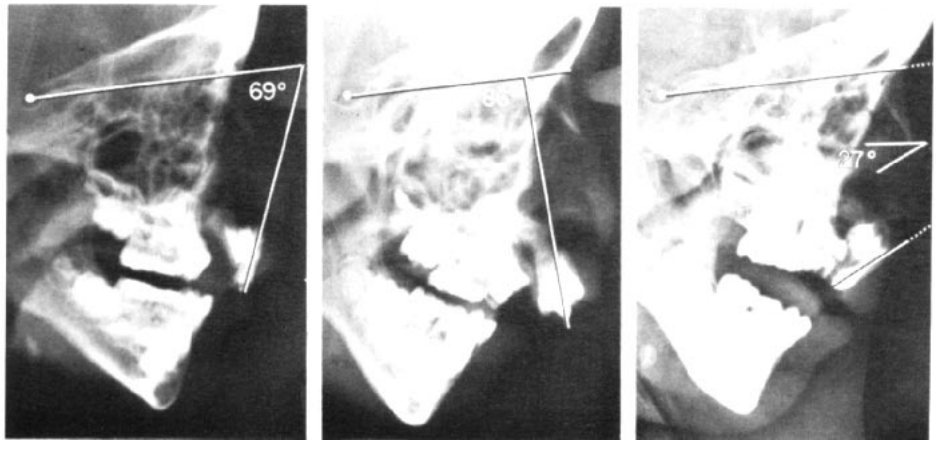
Fig. 2 Variation in buccal occlusion in the deciduous dentition. Subject 139, no crossbite. Subject 84, crossbite of the canine only. Subject 743, crossbite of maxillary first molar and canine. Subject 517, complete buccal crossbite. Subject 139 has perfect buccal occlusion with severe premaxillary protrusion. Subject 517 has complete buccal crossbite but with minimal premaxillary protrusion.



210 ♀ 4yr. 4mo.
Over-bite = 5mm
Over-jet = 5mm

604 ♂ 4yr 3mo.
Over-bite = 11mm
Over-jet = 14mm

Fig. 3 Lateral cephalometric radiographs of two subjects illustrating overjet (OJ) and overbite (OB). The protrusion of the premaxilla in case 604 was judged sufficiently disfiguring to require vomer resection and retropositioning of premaxilla at age 4 years 11 months.



746 ♀
4-8-13

742 ♂
5-2-16

174 ♂
3-11-13

Fig. 4 Lateral cephalometric radiographs illustrating various axial inclinations of the maxillary central incisors. A lingual inclination of the incisor was almost invariably observed (left). Only in patients with extreme premaxillary protrusion did the incisor to SN approach normal (center). The severe lingual inclination of the incisor, coupled with the lingual torque of the premaxilla and anterior nasal spine, contributed toward a distortion of the integumental profile of the upper lip, columella and nasal tip (right).

TABLE.II

Anteroposterior Molar Relation in the Deciduous Dentition of Bilateral Complete Cleft Lip and Palate

	Noncleft N = 324	Bilateral Complete CL + CP N = 26	
Angle Classification	%	No. of Cases	%
I	78.2	18	69.2
I and II on opposite sides	—	4	15.4
II	20.9	3	11.5
III	0.9	1	3.8

The mean age was 4 years, 1 month with standard deviation of ±6 months. Noncleft population was between 4 and 5 years of age and the data were derived from Seipel.[3]

Results

The molar relation in the deciduous dentition of the bilateral complete cleft lip and palate population was similar to that observed in a noncleft population of similar age by Seipel[3] (Table II).

Crossbites of first and second molar and canine teeth were judged to be present or absent, complete or incomplete, unilateral or bilateral. The influence of the molar relationship and repair versus unrepair of the palate on the prevalence of crossbite was evaluated.

The prevalence and severity of crossbite was greater on the cleft sides that were in neutroclusion (Class I) than on the sides in distoclusion (Class II). In the one case that was in mesioclusion (Class III) both sides demonstrated molar crossbite (Table III). The prevalence and severity of crossbite was similar on right and left sides.

The cleft population was divided into two groups: those whose palates were repaired (n=22) and those whose palates were not repaired (n=4) at the time of the study. Since crossbite was almost completely absent in the latter group, the following observations were limited to the twenty-two cases for which articulated study models were available that postdated soft and hard palate repair. No crossbite whatsoever was observed in 31.8% of this population. Crossbite limited to the deciduous canines was recorded in

TABLE III

Angle Molar Relation and Crossbite in the Deciduous Dentition in Bilateral Complete Cleft Lip and Palate: Each Side Considered Separately

Classification	No Crossbite	Canine Crossbite	Canine & Molar Crossbite
Class I	17	14	8
Class II	7	4	—
Class III	—	—	2

TABLE IV

Comparison of Crossbite in the Deciduous Dentition of Noncleft, Unilateral, and Bilateral Cleft Lip and Palate Populations

	Percent of Subjects with Crossbite		
Occlusion	Noncleft	Unilateral Cleft	Bilateral Cleft
No Molar or Canine Crossbite	94.8	39.5	31.8
Canine Crossbite	—	30.3	36.4
Canine & Molar Crossbite	5.2	30.2	31.9
No Incisor Crossbite	98.1	81.8	95.5
Incisor Crossbite	1.9	18.2	4.5

All observations in the cleft groups were made from study models that postdated palatal repair. The data for the noncleft group were from the Burlington Orthodontic Research Center[5] and for unilateral clefts were adapted from Pruzansky and Aduss.[6]

36.4%. Unilateral crossbite of one or both molars was observed in 18.2% and bilateral crossbite of the molars was observed in 13.7% of the patients. Molar crossbite thus occurred in less than one third of the sample.

Table IV compares the prevalence of crossbite in the bilateral cleft population to a noncleft population[5] and to a population of complete unilateral clefts derived from our own center.[6]

The interdental widths postdating palatal surgery for the maxillary and mandibular canines and molars were compared with the norms established by Moorrees for each sex and age.[2] The mean standard scores of the interdental widths of the maxillary deciduous canines and molars were all more than two standard scores below the norm (4.5 standard scores for the canine and averaging 2.5 for the molars). Thus the maxillary dental units reflected an aberrant medial position of the lateral maxillary shelves. The interdental width of the maxillary deciduous canines was especially contracted; however, the interdental width of the mandibular counterpart hardly varied from the norm. The contraction of the maxillary buccal segments was to some degree compensated by narrower interdental widths of the mandibular deciduous molars, about one standard score below the norm.

The overjet for the total sample was 9.7 mm ±5.4 mm. In the noncleft population at 4 years of age less than 10% had overjets above 5 mm. On the other hand, 80% of the bilateral cleft group had such overjets (Table V).

The cleft population was divided into two groups: the six requiring subsequent premaxillary setback or excision and the twenty patients that did not undergo these procedures. The overjet for the first group was 16.7 mm ± 3.8 mm and for the second group 7.6 mm ± 4.7 mm. Apparently the severity of overjet was an important

TABLE V

Frequency of Different Degrees of Incisor Overjet in Bilateral Complete Cleft Lip and Palate and in a Noncleft Population

Overjet in MM.	Frequency in Percent	
	Noncleft N = 324	Bilateral CL + CP N = 26
0.0	1.2	3.8
0 to 2.5	48.8	3.8
2.6 to 5.0	41.7	11.5
5.1 to 10.0	—	46.2
10.0	8.3	34.6

The cleft population was 4 years, 1 month ± 6 months and the noncleft population was between 4 and 5 years of age. The noncleft group was derived from Seipel.[4]

TABLE VI

Axial Inclination of the Maxillary Central Incisors to the Sella Nasion Plane in Bilateral Complete Cleft Lip and Palate

Group	Number	Inclination of Maxillary Central Incisor (Imax to SN) Mean ± S.D.
Noncleft Boys	25	94.9 ± 7.0
Noncleft Girls	25	92.7 ± 6.4
Bilateral CL + CP	26	64.3° ± 15.2°
—No premaxillary Surgery	20	59.2° ± 13.5°
—Premaxillary surgery later performed	6	81.3° ± 7.2°

The cleft children were 7 years, 1 month ± 6 months of age. The data from noncleft children aged 4 years were derived from Higley.[7]

factor in influencing the clinical decision for secondary premaxillary surgery (Figure 3). Only one subject presented a negative overjet, or anterior crossbite (Figure 5).

The overbite for the total sample was 4.3 mm ± 4.2 mm. This overbite was somewhat greater than the norm of approximately 2.5 mm reported for a noncleft group of similar age.[4]

The inclination of the maxillary central incisors to SN in the deciduous dentition of the total bilateral cleft population showed a decided lingual angulation (64.3° ± 15.2°). When compared with a noncleft population of similar age, the cleft group demonstrated about a 30° lingual version of the incisors (Table VI).[7] In the group of six patients in which subsequent premaxillary surgery was required, the axial inclination of the maxillary central incisor was 81.3° ±7.2°. This inclination was slightly more lingual than the norm. The group that did not require premaxillary surgery demonstrated severe lingual version (59.2° ± 13.5°) of the incisal teeth.

An inverse relation was demonstrated

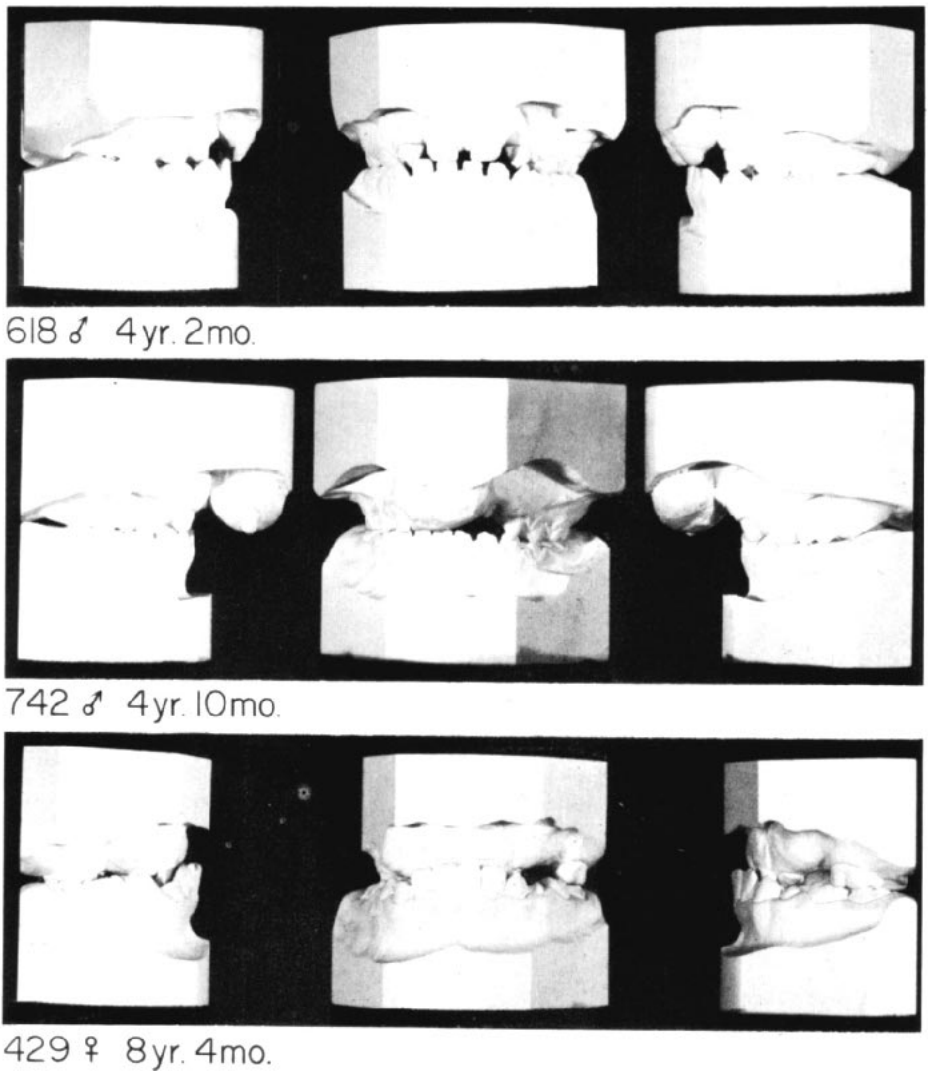


Fig. 5 Articulated study models demonstrating the variation in premaxillary position in the deciduous dentition of complete bilateral cleft lip and palate. In patient 618 note favorable position of premaxilla and crossbite limited to the canine. In patient 742 the premaxilla is severely protrusive and the buccal segment is in Class II relation without crossbite. Because of the difficulty in retropositioning of the premaxilla and the forward position of the maxillary dentition the surgeons elected to excise the premaxilla in this instance. In patient 429 the maxilla is in total crossbite except for one maxillary molar. This was the only subject in which an anterior crossbite was also recorded.

between the incisal overjet and incisal inclination (—0.65); the more severe the overjet, the less acute the degree of incisor inclination, and the more moderate the overjet, the more acute the incisor inclination.

There was a direct correlation between severity of overjet and overbite (+0.34); the more severe the overbite, the greater the incisor overjet.

Discussion

The present investigation is primarily concerned with the analysis of the occlusion of the complete deciduous dentition in a homogenous population of complete bilateral cleft lip and palate. There are several reasons why this approach has been taken. The occlusion of the teeth may be regarded as an index to jaw development. For example, anteroposterior dysplasia due to an underdeveloped maxilla may be reflected in the precise interdigitation of the maxillary and mandibular dentition. Collapse of the palatal shelves or restricted lateral maxillary development may be reflected in a lingual interdigitation of the maxillary posterior teeth.

The deciduous occlusion was selected because it is less subject to the multiple factors that contribute to malocclusion in mixed and permanent dentitions. For instance, overcrowding of the dentition and secondary problems developing from the effects of untreated caries are more prevalent in the permanent dentition and could obscure the effects on occlusion that stem directly from the presence of the cleft and its subsequent treatment. The dental casts and cephalometric records were analyzed at age four years which generally coincided with the completion of the major surgical procedures for repair of the lip and palate. This report permits an assessment of at least the short term effects of such procedures. It is understood that final judgments of the habilitative process cannot be made until late adolescence when growth has had more complete expression.

Finally, the immediate preschool age period is an important milestone in the appraisal of the goals of the habilitative program and in determining the child's readiness for his entry into the educational and social environment that will affect his important formative years in society.

The overriding problem in this series of complete bilateral clefts of the lip and palate was the persistent projection of the premaxilla. The premaxillae in six out of twenty-six subjects were judged by the surgeons managing the cases to be so disfiguring that surgical removal or setback was performed during the preschool years (Figure 3). Other patients of similar age had a relatively favorable premaxillary position, while in some the premaxilla presented serious problems in orthodontic and/or surgical management (Figure 5).

The severity of premaxillary protrusion in the homogenous population of bilateral complete clefts was variably expressed and required individualized management. Dental overjet measured on the casts or lateral cephalometric radiographs correlated with cephalometric measurements of premaxillary protrusion.[1] In the present series only 19% had overjets less than 5 mm, while severe overjets of 10 mm or more were recorded in over one third of the population (Table V). In contrast, the overjet did not exceed 5 mm in over 90% of a noncleft population.

Data from other centers on bilateral clefts of the lip and palate are at variance with our findings (Table VII). Derichsweiler and Kling observed that incisor crossbite rather than incisor

TABLE VII

Prevalence of Crossbite in Bilateral Cleft Lip and Palate as Reported in the Literature.[8,9,11,12]

Author	Completeness of Cleft	Dentition Observed	Presurgical Orthopedics & Bone Grafting	Palate Repaired	No. Cases	% Molar Crossbite			% Anterior Crossbite	
						None	Unilat	Bilat	Absent	Present
Present Series	Complete	Deciduous	No	Yes	22	68.2	18.2	13.7	95.5	4.5
				No	4	100.0	0.0	0.0	0.0	0.0
Kling, '64	Complete	Deciduous	Yes	Yes	14	0.0	64.3	35.7	28.6	71.4
Derichsweiler, '64	Complete	Deciduous	Yes	No	30	6.7	93.3 Molar & Anterior Crossbite			
			No	No	40	10.0	90.0 Molar & Anterior Crossbite			
Anderson & Dahl '64	Not Stated	Not Stated	No	Yes Vomer Flap about 2 mos.	Not Reptd.	9	20	71	Not Reported	
Hagerty, et al, '64	Not Stated	Deciduous Mixed Complete	Not Stated		16	44	0	56	Not Reported	

overjet was the frequent occurrence.[8,9] In Kling's series of bilateral clefts, treated with presurgical orthopedic and bone grafting techniques, over 70% of the patients had lingual placement of the maxillary incisors. In the present series only one patient had lingual positioning of the maxillary incisors.

The severity of overjet was apparently a factor in deciding which patients required secondary set-back or removal of the premaxilla. This subgroup of six patients had a mean overjet of 16.7 mm while the mean overjet was 9.7 mm for the whole group of bilateral clefts.

The inclination of the maxillary incisors in the bilateral cleft lip and palate group was variable (Table VI). Patients with extreme premaxillary protrusion often had relatively normal incisal inclination, while those with more moderate overjet displayed severe lingual inclination of the incisors (Figure 5). This correlation between overjet and incisor inclination (—0.65) might be explained by the fact that when overjet is severe the lip musculature after repair tends to ride above the premaxilla and exerts little influence on its position, but when the overjet is moderate the repaired lip causes lingual displacement of the premaxilla.[1]

Serious consideration must be given the molar occlusion in the presence of a cleft. Medial collapse of maxillary palatal segments, or maxillary hypoplasia is often associated with the cleft or its surgical repair. The dental manifestation of the above is buccal crossbite of the molar teeth.

In the present series evaluated after palatal surgery, some form of molar crossbite was observed in 31.9% of the cases (unilateral crossbite 18.2%, bilateral crossbite 13.7%). In a noncleft population of similar age, only 5% of the cases had buccal crossbite.[5] It must be pointed out that in no instance was the crossbite so severe that the buccal segments were not in functional occlusion (Figure 2). Further, the crossbite that was present was judged to be readily correctable by simple orthodontic expansion appliances.

Kling and Derichsweiler reported that buccal collapse in complete bilateral clefts was an almost constant feature despite the use of presurgical orthopedics and bone grafting (Table VII). The severity, as well as frequency of the buccal collapse, was much greater in their experience than in the present report. Kling reported an incidence of 64.3% unilateral crossbite and 35.7% bilateral crossbite in bilateral clefts. Derichsweiler reported on two series of complete bilateral clefts; one group had lip closure only, and the other group, in addition to lip repair had bilateral osteoplasty to produce fixation of the premaxilla. He found that 90% of the cases exhibited molar and anterior crossbite in both series.

Bilateral cleft lip and palate poses a problem similar to complete unilateral cleft lip and palate previously considered by Pruzansky and Aduss.[6] One might expect a higher prevalence of crossbite in double clefts than in unilateral cleft lip and palate. The results, summarized in Table IV, indicated that only when crossbites for the two sides of the bilateral were added, did the percentage of crossbite equal that in the unilateral.

The interdental widths of the deciduous mandibular molars is about one standard score narrower than recorded in a noncleft sample of equivalent age. Whether this is a reflection of a smaller mandible observed in cleft patients or a functional adaptation to the narrow interdental width of the maxillary dentition is open to specula-

tion.[9] Undoubtedly, this narrow mandibular molar width is a factor in minimizing the incidence of buccal crossbite.

Where the maxillary dentition was positioned more anterior than normal, the frequency of crossbite was reduced (Table III). This was probably because the maxillary teeth articulated with a narrower portion of the mandibular arch. In such patients the management of the anteriorly positioned premaxilla was aggravated (Figure 5, Patient 742). The frequency of a Class II molar relationship observed in this study was similar to that observed in a noncleft population (Table II).

Buccal crossbite was recorded separately for four patients that did not have their palates repaired at the time of the study. This was done because palatal surgery could be an important factor in causing collapse of the arch or restricting maxillary growth. None of the four patients exhibited molar crossbite and only one had canine crossbite. It could also be reasoned that palatal surgery was postponed in this group because of the excessive width of the cleft relative to available lateral tissue that could be mobilized to close the cleft. Possibly patients whose palatal shelves were overexpanded were judged less suitable for palatal reconstruction at an early age.

In the present series of bilateral clefts, the dominant cosmetic and functional problem is related to the overgrowth of the premaxillary vomerine stalk and the management of the premaxillary protrusion. Curiously the major focus of attention in many cleft palate centers is the prevention of maxillary constriction which causes posterior and anterior crossbite.

Well-documented longitudinal studies on homogenous cleft samples can provide a rational basis for the most efficacious habilitative procedures. Unfortunately, the heterogeneity of surgical procedures employed, variations in surgical experience and skills, different standards for selection of patients, and lack of standardization of evaluation make comparisons between centers difficult. Nevertheless, the apparent disparity in results by different centers commands attention to determine if any variables in treatment procedure account for the real differences in the end-results.

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