Facial and Dental Relationships of Individuals with Unoperated Clefts of the Lip and/or Palate

SAMIR E. BISHARA, D.D.S., D. ORTH., M.S.
CHARLES J. KRAUSE, M.D.
WILLIAM H. OLIN, D.D.S., M.S.
DAVID WESTON, D.D.S.
JOHN VAN NESS, D.D.S.
CHARLES FELLING, M.A.

Iowa City, Iowa 52242

Twelve individuals with unoperated unilateral clefts of the lip and palate and eight with unoperated unilateral clefts of the lip and alveolus were examined clinically and cephalometrically. The two groups were compared to each other and to a matched sample of normal individuals. All subjects were examined in their native India.

Based on the findings of this investigation, it is suggested that, in general, the cranial base and skeletal face are not extensively malrelated in individuals with either unoperated unilateral clefts of the lip and palate or of the lip and alveolus when compared to matched normals. Yet, there are distinct differences in dentoalveolar and skeletal relations between both cleft groups and normals and between the two cleft groups.

Introduction

The literature is abundant with investigations describing differences in dentofacial relations between cleft and non-cleft populations. These differences can be attributed to any one or combination of the following factors: a) the management of the cleft lip and/or palate, b) adaptive changes resulting from the mechanical presence of the cleft, and c) genetic pattern.

Since cleft populations available for study in the United States are usually managed surgically at relatively early ages, it is impossible to use them to study the relative role of any of the previously mentioned factors. On the other hand, assessment of unoperated cleft individuals makes it possible to eliminate the influence of cleft management on facial morphology and enables us to describe the dentofacial relations of the "original" cleft face. Comparisons between the skeletal and dental relationships of unoperated and operated cleft individuals should determine the effect of management (good or bad) on facial growth.

Drs. Bishara, Krause and Olin are affiliated with the cleft palate program at the University of Iowa, Iowa City Iowa. Drs. Weston and Van Ness are affiliated with St. Christofer's Hospital Philadelphia, Pa. Dr. Felling is affiliated with State Services for Crippled Children, University of Iowa.

This project was supported by the Church of Good Shepherd in Rosemont, Pennsylvania, and by Public Health Research Grant DE-00853, National Institute of Dental Research, Bethesda, Maryland.

A review of the literature describing the craniofacial growth of individuals with different types of unoperated clefts leads one to conclude that (a) very little is available concerning the dentofacial relationships of individuals with unoperated clefts of the lip and alveolus (Innes, 1962); (b) palatal surgery does not affect the vertical and anterior-posterior skeletal relationships of individuals (Bishara, 1973; Dahl, 1970; Haggerty and Hill, 1963) with isolated clefts of the palate; and (c) there are controversial and hence inconclusive findings regarding the facial morphology of individuals with unoperated clefts of the lip and palate (Atherton, 1967; Ortiz-Monasterio, et al, 1959; Ortiz-Monasterio, et al, 1966; Pitanguy and Franco, 1967). This study was designed to shed additional light on the questions still remaining relative to dentofacial development in unoperated cleft subjects as compared to normal subjects.

Method

SUBJECTS. A total of 20 individuals with unoperated clefts of the lip and/or palate were examined at the Mar Thoma Mission Hospital in Chungathara, Kerala, in Southern India. The population of Chungathara is mostly of Dravidian heritage. These people, in general, are of relatively smaller stature than North American Caucasians and have a greater tendency to have bimaxillary dental protrusion.

Of the 20 cleft individuals examined, 12 had complete unilateral clefts of the lip and palate (UCLP), and eight had unilateral clefts of the lip and alveolus (UCLA). Detailed information on both the cleft and non-cleft subjects is presented in Table 1.

It should be pointed out that the age range of the unoperated sample is large. Hence, the normal sample was collected to match the age and sex of each cleft individual. The maximum difference between a cleft and a matched normal subject was one year.

TABLE 1. Detailed Information on the Normal and Unoperated Cleft Groups.

group examined	*sample size*	$\bar{x}$ *age and range in years*
Unilateral CLP*		
Males	8	15.6 (7.0–29.0)
Females	4	20.8 (16.0–32.0)
Total	12	17.3 (7.0–32.0)
Unilateral CLA**		
Males	3	10.7 (8.0–13.0)
Females	5	9.4(7.0–17.0)
Total	8	10.2 (7.0–17.0)
Normals		
Males	19	17.7 (7.0–25.0)
Females	24	15.2 (7.0–35.0)
Total	43	16.3 (7.0–35.0)

* Of these, 11 individuals had both cephalograms and dental models while for one, only cephalograms were available.

** Of these, 6 individuals had both cephalograms and dental models, and two had only cephalograms.

Procedure

Prior to any lip and/or palate surgery, cephalometric radiographs, dental models, and facial photographs were made. Cephalometric radiographs on forty-three non-cleft individuals from the same population were also obtained.

The landmarks used in this investigation are illustrated in Figure 1. A detailed

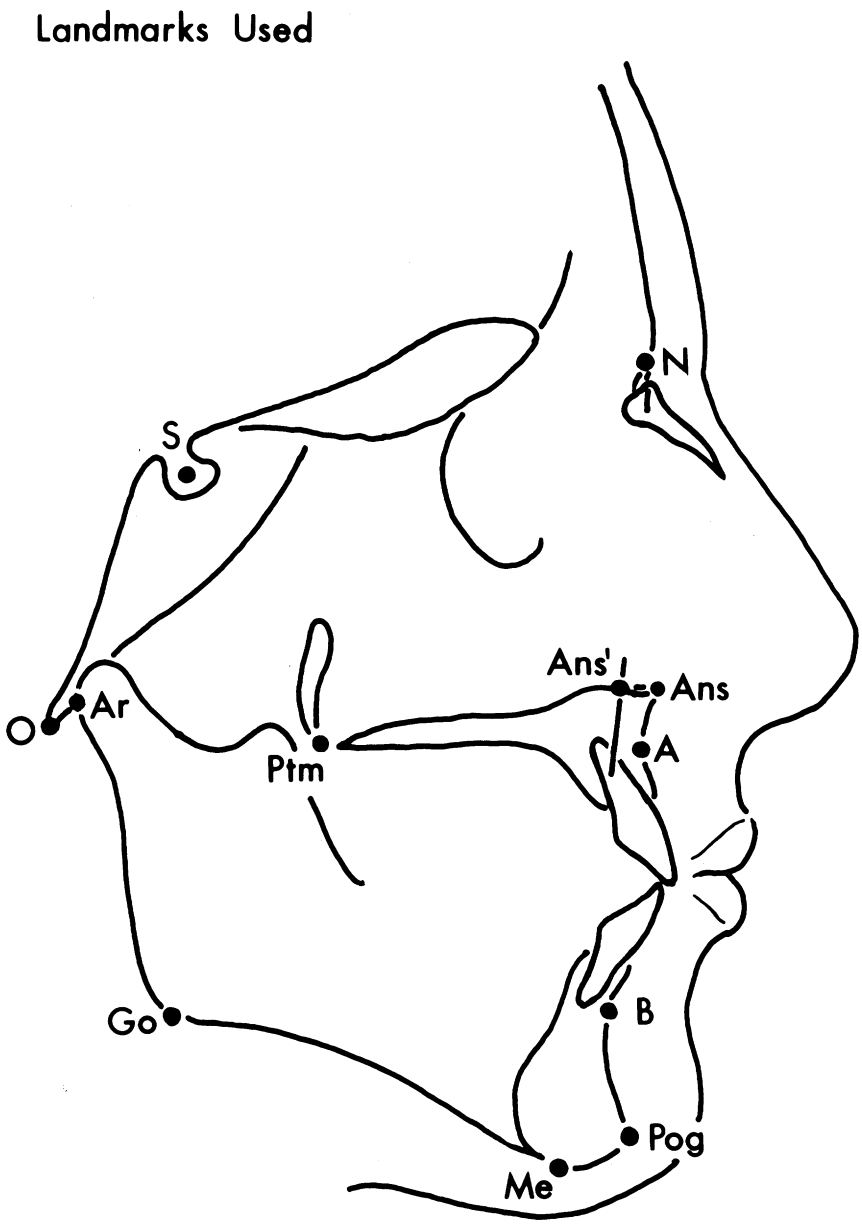

FIGURE 1. Landmarks Used.

definition of these landmarks has been presented elsewhere (Bishara, 1975; Bjork, 1947; Krogman, 1957; Meredith, 1959). From these landmarks, 12 angular and seven linear measurements were obtained. In addition, six ratios were derived from the linear dimensions. The cephalometric data obtained were subgrouped to describe the following parameters: Maxillary complex (SNA, SNAns, N-Ans′, Ans-Ptm and Ans-Ptm/S-N); Mandible (SNB, SNPog, NSGn, MP:SN Ar-Pog, Pog-Postp and N-S/Ar-Pog); Maxilla-Mandible (ANB, NAPog, N-Me, N-Ans′/*N*-Me, Ar-Go/N-Me and Ans-Ptm/Pog-Postp); Dental relationships ($\underline{1}$:SN, $\overline{1}$:MP and $\underline{1}$:1) and the cranial base (NSO, N-O, S-N and S-N/N-O).

Information was also collected relative to the incidence and location of crossbite, molar relationships, overbite, overjet, and arch collapse.

Reliability. Both intra-and inter-examiner reliability for the cephalometric measurements were calculated and were found to be within acceptable limits (0.5 degrees for angular measurements and 0.2 mm for linear measurements). The method by which the reliability was determined was based on procedures previously outlined (Bjork, 1947 and Bishara, 1975).

Clinical judgments on arch collapse, molar relation, and crossbite were made by two orthodontists.

Statistics Treatment. To test the significance of observed differences between the cleft and non-cleft populations, the paired t-test was performed since it was possible to match each cleft individual to a corresponding normal individual on the basis of age and sex.

The Welch test was used for intra-cleft group (UCLA and UCLP) comparisons because of its advantage over other tests in two sample hypothesis testing when conditions include unequal sample size and variance heterogeneity (Welch, 1947).

Findings

I. Unilateral Clefts of the Lip and Palate (N = 12)

Clinical Findings. On each side of the cleft, the alveolar processes rolled superiorly. This was accompanied by an infra-occlusion of the teeth adjacent to the cleft. An openbite tendency was sometimes seen in the cleft area and was the result of this infra-occlusion as well as of the tipping of the adjacent teeth into the cleft space.

Different degrees of medial collapse of the cleft segment were present. This was also accompanied by a slight lateral rotation and fanning of the maxillary incisors on the non-cleft side.

Crossbite (Table 2). Of the 11 individuals on whom dental models were available, five (46%) did not have crossbites. Three subjects had unilateral crossbites, and one subject had a bilateral posterior crossbite involving cuspids and first premolars. Two subjects were in complete buccal occlusion on the non-cleft side as shown in Figure 3.

Of the three subjects who had unilateral crossbites, one involved both the

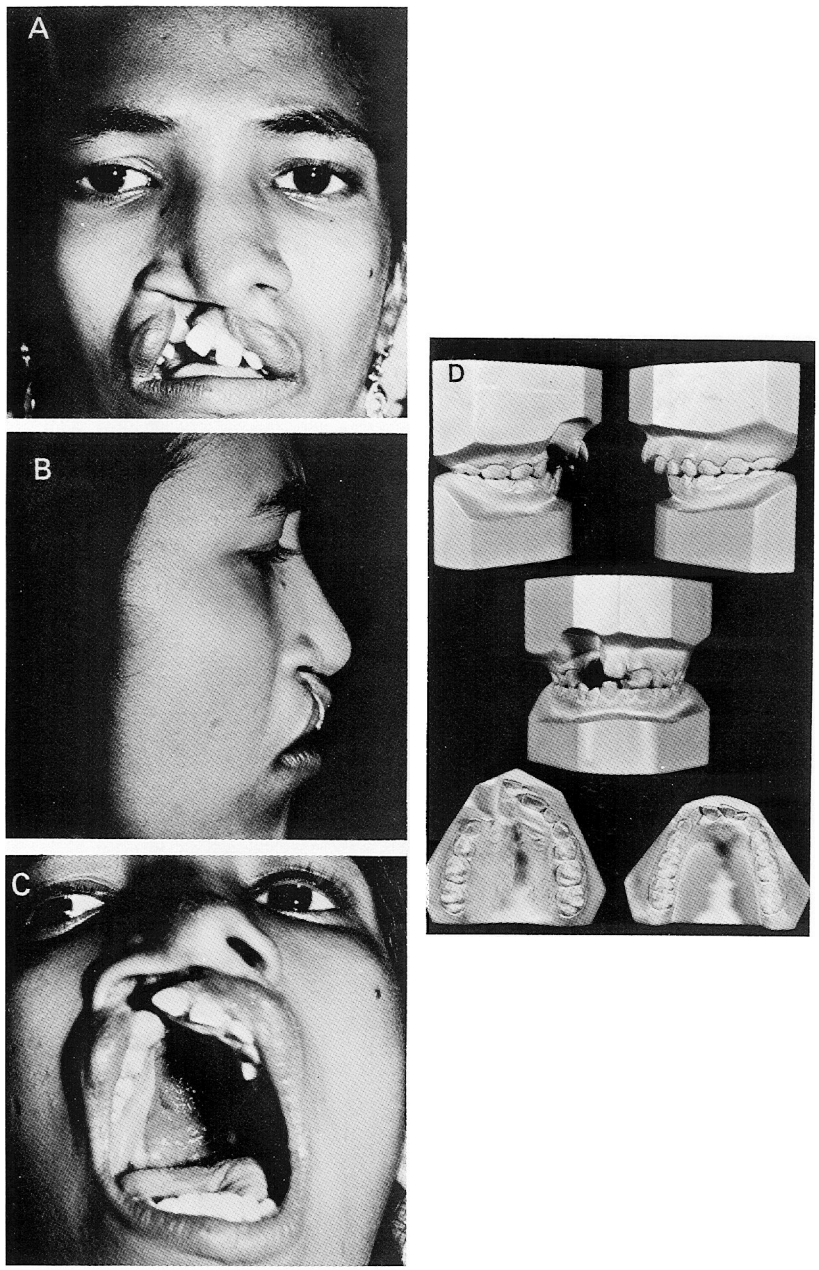

FIGURE 2. Eighteen-year-old female with complete unilateral cleft lip and palate on the right side..

anterior and the posterior segments of the arch, and two had crossbites of the cuspids on the cleft side.

MOLAR RELATIONSHIPS (TABLE 2). Nine of the subjects (83%) had Class I molar relationships while two (17%) had Class II molar relationships.

TABLE 2. Dental Findings on Individuals with Unilateral Cleft Lip and Palate and Unilateral Cleft Lip and Alveolus.

cleft type	*molar relation*			*overbite in mm*		*crossbite*				*buccal bite*
	I	*II*	*III*	*cleft side*	*non-cleft side*	*none*	*anterior/ posterior*	*cuspids*	*bilateral cuspid & premolar*	
UCLP (N = 11)	9 (83%)	2 (17%)	—	0.5 ± 3.2	3.3 ± 3.4	5 (46%)	1 (9%)	2 (18%)	1 (9%)	2 (18%)
UCLA (N = 6)	4 (66%)	1 (17%)	1 (17%)	0.7 ± 3.8	3.2 ± 1.4	4 (66%)	1 (17%)	1 (17%)	—	—

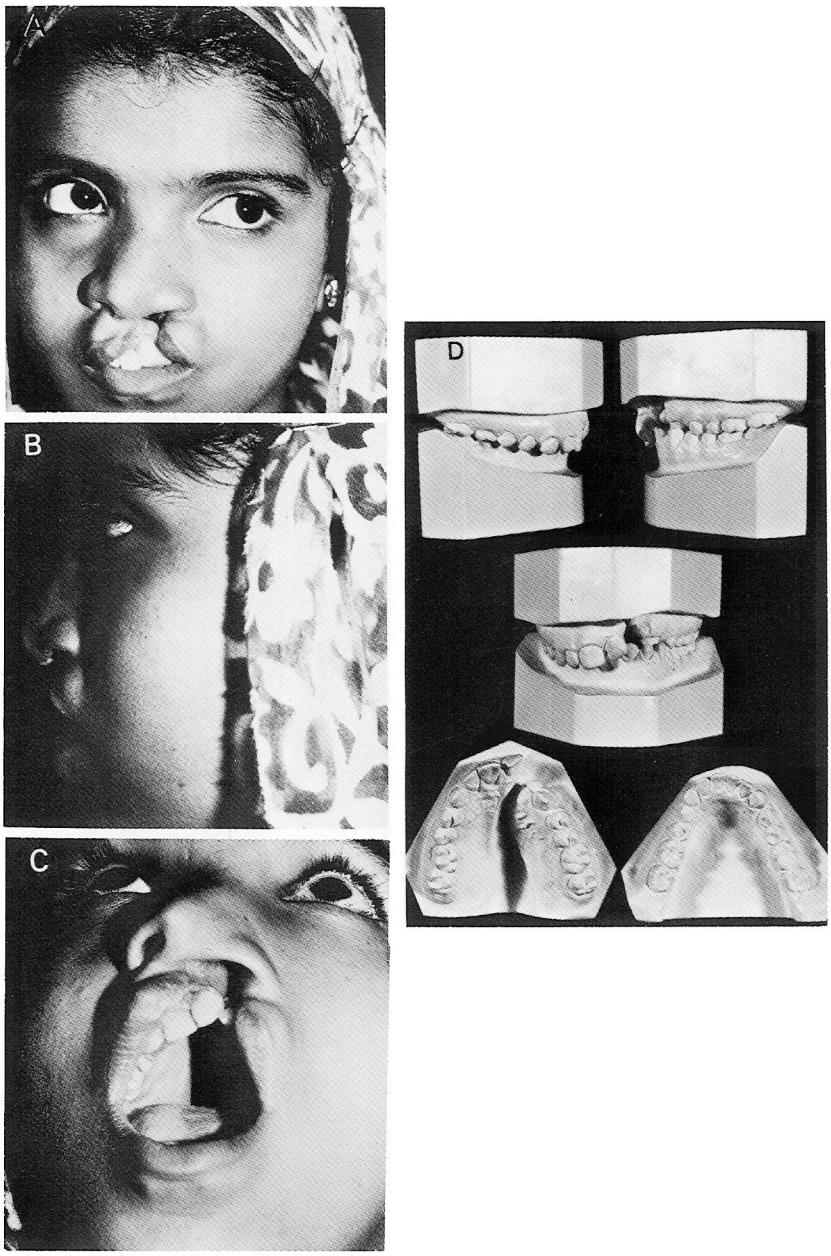

FIGURE 3. Sixteen-year-old female with complete unilateral cleft lip and palate on the left side.

OVERBITE AND OVERJET (TABLE 2). There was a greater degree of overbite ($\bar{x}$ = 3.3 mm) on the non-cleft side of the dental midline than on the cleft side ($\bar{x}$ = 0.5 mm). No differences in overjet were apparent when both sides of the midline were compared.

CEPHALOMETRIC SKELETAL FINDINGS. *Maxillary Complex*—A test of the null

hypothesis indicated a low probability of a population difference in maxillary relationships and dimensions between the UCLP and normal groups.

Mandible—There was a moderately high probability of a population difference in mandibular relationships (p = .08) for both SNPog and MP:SN angles. While this p-value approaches but does not achieve significance at the five per cent level of confidence, it does suggest that there is a tendency for the UCLP population to have a steeper than normal mandibular plane.

The ratio N-Ans′/N-Me was significantly smaller in the cleft group than in the normals (p = .02). This difference was the result of a relatively larger lower face height in the cleft group.

Cranial Base Relationships—There were no significant differences in any of the cranial base parameters.

Cephalometric Dental Findings—The lower incisors were significantly more upright ($\underline{1}$:MP) in the cleft group than in the normal group (p = .03)

II. Unilateral Cleft Lip and Alveolus (N = 8)

Clinical Findings. The alveolar processes and the dentition in the area bordering the cleft are similar to the findings for the UCLP group and are illustrated in Figure 4. However, from the examination of the dental models, it was estimated that, in general, the UCLA group exhibited less medial collapse of the maxillary segment on the cleft side and less lateral rotation of the premaxillary segment on the non-cleft side than did the UCLP individuals.

Crossbite (Table 2). Of the six individuals on whom dental models were available, four (66%) had no crossbite. In the two individuals with crossbite, one involved a central incisor while the other involved a cuspid on the cleft side.

Molar Relationships (Table 2). Of the six subjects examined, four had Class I molar relationships. The other two subjects had Class II and Class III molar relationships respectively.

Cephalometric Skeletal and Dental Findings (Table 3). *Maxillary Complex*—There was a moderately high probability of a population difference in SNA and SNAns (p = .09). While this p-value approaches but does not achieve the usual criterion for significance of difference, it may indicate a

TABLE 3. Statistics on 25 measurements from lateral x-ray cephalograms between individuals with unilateral cleft lip and alveolus and matched normals.

measurements	*UCLA (N = 8)*			*normals (N = 8)*			*t*	*P*
	$\bar{x}$	*S.D.*	*S.E.*	$\bar{x}$	*S.D.*	*S.E.*		
Maxillary Complex:								
SNA (°)	90.1	7.4	2.8	85.2	2.7	1.0	1.97	.09
SNAns (°)	93.8	8.3	2.5	88.2	2.5	1.0	1.60	.09
Ans-Ptm (mm)	56.7	3.3	1.2	50.1	3.3	1.2	5.15	.002
Ans-Ptm/S-N (×100)	85.6	9.4	3.5	77.7	4.4	1.6	2.74	.03
Maxilla-Mandible:								
ANB (°)	12.3	5.2	1.9	5.9	0.9	0.3	3.66	.01
NAPog (°)	26.2	10.5	3.9	13.4	2.6	1.0	3.79	.009
Ans-Ptm/Pog-Postp (×100)	80.4	7.1	2.7	69.6	3.1	1.2	4.21	.006
Dental Relations:								
1:MP (°)	111.0	6.3	2.4	101.5	2.8	1.0	4.74	.003
$\underline{1}$:$\bar{1}$ (°)	107.9	10.3	3.8	114.7	6.7	2.5	−2.84	.03

tendency for a relative protrusion of the anterior portion of the maxilla in the UCLA group as compared to normals.

Maxillary Depth (Ans-Ptm) was significantly greater (by 6.6 mm) in the cleft group (p = .002) than in the normal group. All ratios which incorporated maxillary depth were also significnatly different.

Mandible—No significant differences were found between the cleft and normal groups in either the size or the position of the mandible.

Maxillary-Mandibular Relationships—Both the ANB and NAPog angles were significantly larger (p = .01) in the cleft than in the normal group. This difference was due to the relative maxillary protrusion in the cleft group.

Cranial Base—There was a moderately high (p = .09) population difference in the cranial base angle (NSO) indicating a tendency for a larger angle in the UCLA group.

Dental Relationships—The inclination of the lower incisors ($\bar{1}$:MP) was approximately 10° more labial in the cleft group than in the normal group (p = .003).

III. Unilateral Cleft Lip and Palate Compared with Unilateral Cleft Lip and Alveolus

In most individuals with UCLP and UCLA, the columella and nasal septum were deviated to the non-cleft side. The incisors on the other hand were deviated toward the cleft side (Figures 2–4).

In the UCLP group there was, in general, a more pronounced medial rotation of the maxillary segment on the cleft side and a more pronounced lateral rotation on the non-cleft side than in the UCLA group.

Crossbite (Table 2). There was a similar incidence of crossbite in the UCLP group (36%) and in the UCLA group (34%), but two individuals in the former group had a complete buccal occlusion (Figure 3).

Molar Relation. Molar relations were essentially similar in both groups. The one case with a Class III molar relation in the UCLA group was due to early loss of deciduous teeth and the resulting mesial movement of the lower first molars.

Cephalometric Skeletal and Dental Findings (Table 4). *Maxillary Complex*—There was a high probability of a population difference in SNA (p = .04) and SNAns (p = .01) indicating a relative maxillary protrusion. The ratio Ans-Ptm/S-N reflected a tendency for maxillary depth to be greater in the UCLA group (p = .04).

Mandible—There was a high probability of population difference in NSGn (p = .02) and a moderately high level of differences in MP:SN (p = .08), indicating a tendency for mandibular retrusion and a steeper mandibular plane in the UCLP group.

In addition there was a high probability of differences existing between the two groups in mandibular length (Ar-Pog) which was greater in the UCLP group (p = .03).

Maxillary-Mandibular Relationships—The comparisons between the two cleft groups resulted in a high probability of a population differnece in ANB (p = .03) and NAPog (p = .02). The difference in maxillary-mandibular

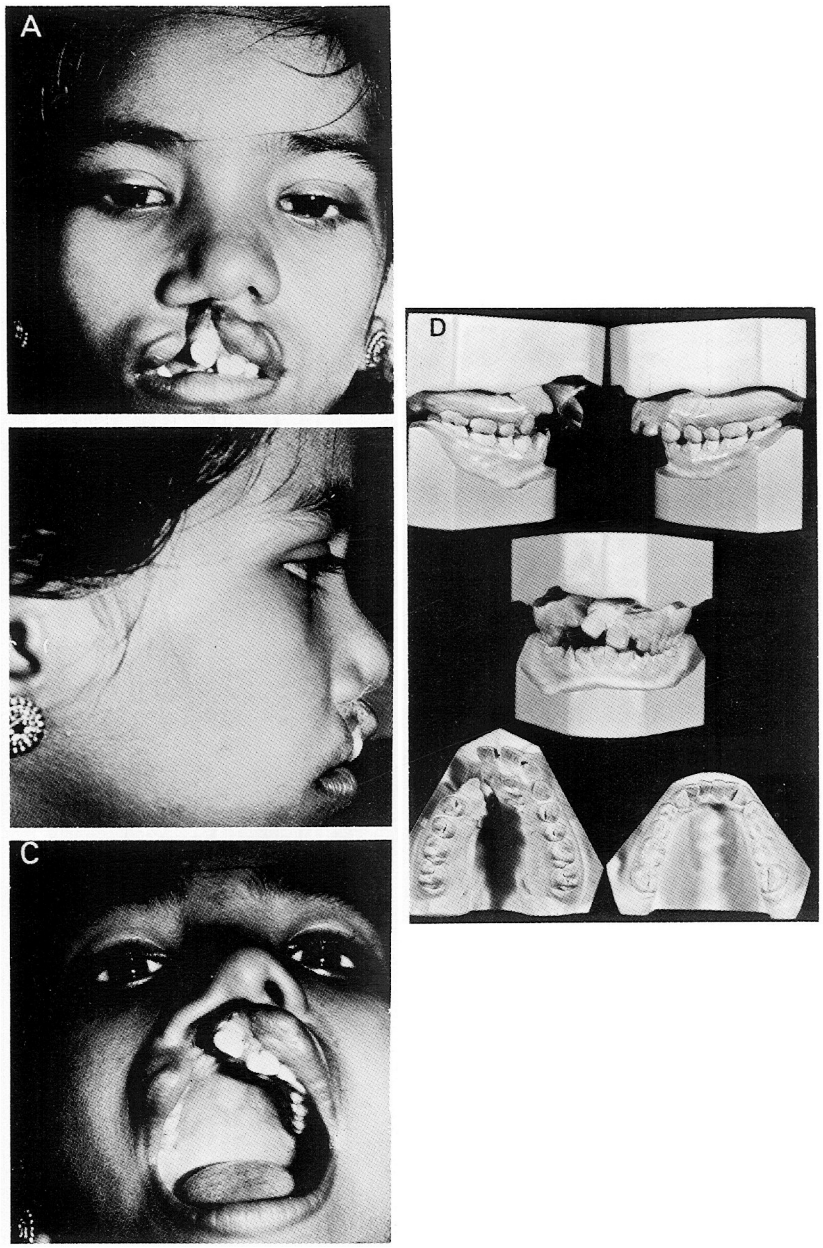

FIGURE 4. Seven-year-old female with complete unilateral cleft lip and alveolus on the right side.

relationships is the result of a relative maxillary protrusion in the UCLA group and a relative mandibular retrusion in the UCLP group.

Comparisons of total face height (N-Me) between the two cleft groups indicated a high probability ($p = .01$) of a larger face height in the UCLP group.

TABLE 4. Statistics on 25 measurements from lateral x-ray cephalograms between individuals with unilateral cleft lip and palate and individuals with unilateral cleft lip and alveolus.

measurements	*UCLP (N = 12)*			*UCLA (N = 8)*			*t-test*	*P*
	$\bar{x}$	*S.D.*	*S.E.*	$\bar{x}$	*S.D.*	*S.E.*		
Maxillary Complex:								
SNA(°)	83.6	3.2	0.9	89.8	6.9	2.4	−2.34	.04
SNAns(°)	86.4	4.0	1.0	93.8	8.3	2.5	−2.88	.01
N-ANS′(mm)	46.1	4.9	1.4	41.8	6.1	2.1	1.65	.012
Ans-Ptm(mm)	53.0	4.2	1.2	56.4	3.4	1.2	−1.92	.07
Ans-Ptm/S-N(×100)	77.4	5.5	1.5	85.3	8.8	3.1	−2.24	.04
Mandible:								
NSCn(°)	69.9	3.4	0.9	66.1	3.3	1.1	2.45	.02
MP:SN(°)	37.7	5.7	1.6	33.4	4.2	1.5	1.93	.07
Ar-Pog(mm)	100.3	10.8	3.1	91.8	6.1	2.1	2.22	.03
N-S/Ar-Pog(×100)	68.7	5.2	1.5	71.5	2.5	0.9	−1.83	.08
Maxilla-Mandible:								
ANB(°)	7.2	3.9	1.1	12.1	5.0	1.7	−2.31	.03
NAPog(°)	14.9	8.9	2.6	26.2	9.8	3.4	−2.60	.02
N-Me(mm)	112.9	13.2	3.8	98.7	9.3	3.3	2.81	.01
Ans-Ptm/Pog-Postp(×100)	71.3	8.8	2.5	80.6	6.6	2.3	−2.67	.01
Dental Relationships:								
$\bar{1}$:MP(°)	97.4	6.0	1.7	109.9	6.7	2.3	−4.26	.001
Cranial Base:								
N-O(mm)	101.3	7.7	2.2	95.4	6.4	2.2	1.84	.08
SN/NO(×100)	67.8	2.2	0.6	69.5	0.9	0.3	−2.46	.02

Cranial Base—There was a moderately high probability of population difference (p = .08) in total cranial base length (N-O) indicating a tendency for a longer cranial base in the UCLP group. This was also reflected in the ratio N-S/S-O (p = .02).

Dental Relationships—The lower incisors ($\bar{1}$:MP) were significantly (p = .01) more retruded in the UCLP group by about 12°.

Discussion

Most investigators agree that differences in maxillofacial growth and development exist in individuals with clefts of the lip and/or palate who have undergone surgery in childhood when compared with non-cleft individuals. The causes of these differences, however, are still controversial.

It was suggested (Bishara, 1973) that differences in facial morphology between cleft and non-cleft populations might be the result of any of the following factors: a) inherited trait, i.e., genetic influences on size and form; b) acquired traits, i.e., biomechanically obligatory adaptive changes in size and form (Chierici, et al., 1973); c) induced traits, i.e., changes in growth (size and form) imposed through surgical, orthopedic, or orthodontic management; and d) combinations of several of these factors along with others not yet identified.

Careful study of cleft individuals who have completed their maxillofacial growth and development without surgical intervention may offer some insight as to which types of growth inhibition might be inherited or biomechanically compensatory in origin and which might be iatrogenic.

In our attempt to understand maxillofacial growth and development in cleft lip and/or palate patients, it may be helpful to seek answers to the following questions:

1. Does the unoperated cleft individual have the same maxillofacial growth potential as the non-cleft individual?
2. Do all unoperated cleft types have the same growth potential?
3. What effects does cleft management have upon facial and dental growth?

The present study was intended to produce information bearing on the first two questions.

The most pertinent findings of this work include:

Arch Form: Both UCLA and UCLP groups had similar tendencies for the cleft side to collapse medially and for the non-cleft side to rotate slightly laterally. These tendencies were more marked in the UCLP group.

Incidence of Crossbite: The UCLP and UCLA groups had crossbite incidence of 36% and 38%, respectively. This is definitely a higher percentage than is seen in the "non-cleft" population in the United States (appproximately 10–15%). However, because of the small sample size in both cleft groups and because no data on the incidence of crossbite in Chungathara are available, any conclusions regarding these parameters should be guarded.

Similar limitations are present relative to the interpretation of the findings on overbite, overjet, and molar relations.

Cephalometric Skeletal Relationships: When the UCLP group was compared to normals, the maxillary complex was not significantly different in either size or relationships. On the other hand, there was a moderately high probability of a population difference in SNPog and MP:SN angles ($p = .08$). This indicated a tendency in the UCLP group examined to have a steeper than normal mandibular plane.

Compared to normals, the UCLA group demonstrated a moderately high probability ($p = .09$) of a population difference in maxillary relationships, indicating a tendency for a relative protrusion of at least the anterior part of the maxilla in the cleft group. Mandibular position in the UCLA group did not differ greatly from normals. The combination of the described relationships were reflected in the larger ANB and NAPog angles in the UCLA group with p-values of .01 and .009, respectively.

Figure 5 represents the facial polygons for the UCLP, UCLA and normal groups superimposed on S-N and registered at S. These polygons help visualize the overall differences in skeletal relations among the three groups evaluated in this investigation.

Thus a tentative answer to whether unoperated clefts have the same dental and skeletal growth potential as non-cleft individuals is that, on the average, the cranial base and face in the unoperated UCLP and UCLA individuals are not extensively malrelated when compared to non-cleft faces. Yet there are distinct differences in dento-alveolar and skeletal relations among the groups examined.

A possible explanation for the different skeletal findings in the two cleft groups investigated is that, in the UCLA group, the unilateral lip defect either allows the premaxilla to rotate in a lateral and anterior direction or allows it to "overgrow." Hence the tendency for a maxillary skeletal protrusion and for the increase in maxillary depth.

On the other hand, the facial skeletal relations which are associated with isolated palatal clefts might in part be "mechanically compensatory" to the cleft

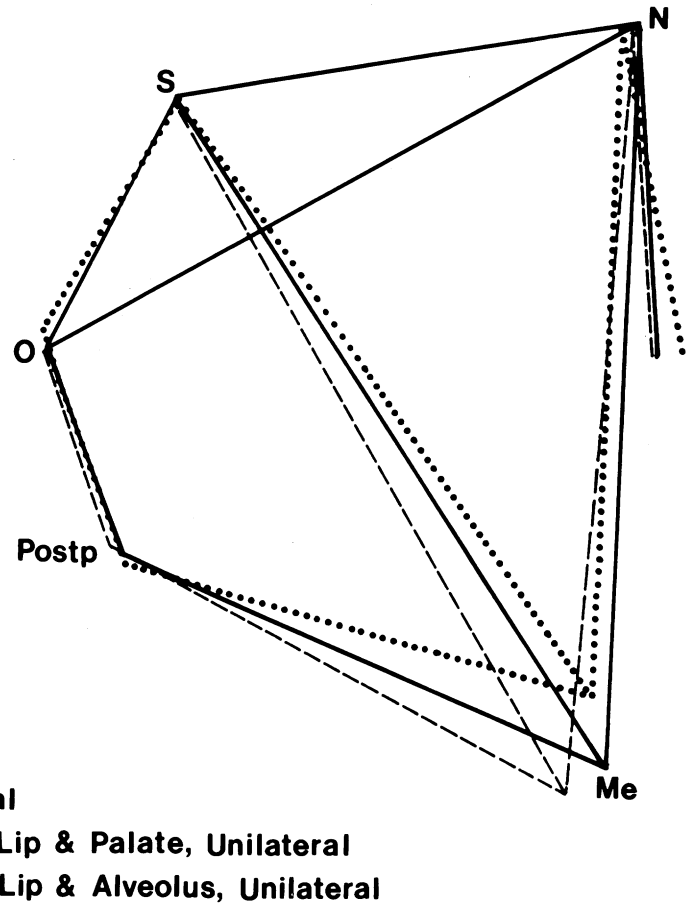

FIGURE 5. Facial polygons comparing unilateral cleft lip and palate, unilateral cleft lip and alveolus, and normals. Superimposition on S-N and registration at S.

defect itself (Chierici, et al., 1973) resulting in the relative retrusion of the maxilla and mandible as well as the steepness of the mandibular plane in that cleft group.

In a previous study, Bishara (1973) compared individuals with isolated clefts of the palate to normals. He found that operated and unoperated cleft individuals had similar cephalometric skeletal relations, yet both groups differed from normal individuals in that the maxilla and mandible were relatively retruded and the mandibular plane was relatively steep.

The facial skeletal relations of the UCLP should theoretically represent an aggregation of the findings in the UCLA and CPO groups. On the other hand since UCLP defects generally present a more severe deformity than either of the other two clefts occurring alone, it may be rather simplistic to expect an exact summation of the previously described skeletal relations for UCLA and CPO.

In this investigation, the UCLP group, when compared to normals, expressed

a moderately high probability for mandibular retrusion and a steeper mandibular plane accompanied by a significantly greater lower face height. The reason that the UCLP group does not express the same tendency for maxillary protrusion and increase in maxillary depth as the UCLA group may be related either to the severity of the cleft defect or to changes which might accompany the presence of a palatal defect.

Cephalometric Dental Relations: In the UCLP and UCLA groups, the maxillary incisor inclination was not significantly different from normals. The lower incisors, on the other hand, were relatively more labially tipped in the UCLA group and more lingually tipped in the UCLP group when both were compared to normals and to each other. The lingual inclination of the mandibular incisors in the UCLP group may be related to the tendency of this group to have a steep mandibular plane inclination. A similar tendency was previously found in individuals with isolated clefts of the palate (Bishara, 1973).

Summary and Conclusions

Twelve individuals with unoperated clefts of the lip and palate, eight with unilateral clefts of the lip and alveolus, three with bilateral clefts of the lip and palate, and three with isolated clefts of the palate, were examined clinically and cephalometrically. These two groups were compared to each other and to a matched sample of normal individuals.

Based on the findings of this investigation, it would appear that, in general, the cranial base and skeletal face are not extensively malrelated in individuals with unoperated unilateral cleft lip and palate or cleft lip and alveolus when compared to matched normals. Yet, there are distinct differences in dentoalveolar and skeletal relationships between the two cleft groups and between these groups and normals.

1. Clinical judgments of the dental models indicated that individuals with unoperated unilateral cleft lip and palate and unilateral cleft lip and alveolus expressed the same tendency for a slight medial collapse of the maxillary segment on the cleft side and a lateral rotation of the premaxillary segment on the non-cleft side. These tendencies were more accentuated in the unilateral cleft lip and palate group.

2. In both of these groups, it was observed that, on each side of the cleft, the edges of the alveolar process rolled superiorly, accompanied by an infra-occlusion of the teeth adjacent to the cleft.

3. The incidence of crossbite was similar in individuals with unilateral cleft lip and palate and in unilateral lip and alveolus. However, more information is needed on a non-cleft population from the same geographical area to permit meaningful comparisons with normals.

Similar limitations are present on the interpretation of the findings on overbite, overjet, and molar relations.

4. In most individuals with unilateral clefts, as would be expected, the nasal septum and the columella were found to be deviated toward the non-cleft side of the facial midline while the incisor teeth moved in the opposite direction; i.e., toward the cleft side.

5. Individuals with unoperated clefts of the lip and palate were not significantly different from normals in maxillary relation and size. There was a moderately high probability for the mandible to be retruded and for the mandibular plane to be steeper than in the normal group.

6. Individuals with unoperated unilateral clefts of the lip and alveolus showed a tendency for maxillary protrusion in the former group while those with unoperated unilateral clefts of the lip and palate showed a tendency for mandibular retrusion and a steep mandibular plane in the latter group. The lower incisors were significantly more lingually inclined in the unilateral cleft lip and palate group and more labially inclined in the unilateral cleft lip and alveolus group.

The present findings tend to suggest that different cleft types have different clinical, dental, and skeletal characteristics. These findings also indicate that some of what is sometimes considered to be the "untoward effects of surgical management," such as crossbite, may also be present, perhaps to a lesser degree, in unoperated cleft individuals. However, because of the limitations on the sample examined in this investigation, the present findings need to be tested further by examining a larger group of unoperated individuals. This will give further insight into the extent to which surgical intervention alters maxillofacial growth and development in cleft individuals.

reprints: *Dr. Samir E. Bishara*
Orthodontics
College of Dentistry
Iowa City, Iowa 52242

References

ATHERTON, J. D., Morphology of facial bones in skulls with unoperated unilateral cleft palate, *Cleft Palate J. 4,* 18–30, 1967.

BARDACH, J., *Rozoczepy wargi gornej: podniebienia,* Warsaw: Panstwowy Zaklad Wydawnietw Lekarskich, 1967.

BISHARA, S. E., Cephalometric evaluation of facial growth in operated and non-operated individuals with isolated clefts of the palate, *Cleft Palate J. 3,* 239–246, 1973.

BJORK, A., *The Face in Profile,* Svensk-Tandlakare-Tidskrift, Vol. 40, No. 5B, 1947.

CHIERICI, G., HARVOLD, E. and VAGERVIK, K., Morphogenetic experiments in cleft palate: Mandibular response, *Cleft Palate J. 10,* 51–61, 1973.

DAHL, E., Craniofacial morphology in congenital clefts of the lip and palate, *Acta. Odont. Scand. 28,* Suppl. 57, 1970.

HAGERTY, R. F. and HILL, M. J., Facial growth and dentition of the unoperated cleft palate, *J. Dental Res. 42,* 412–421, 1963.

INNES, C. O., Some observations on unrepaired hair-lips and cleft palates in adult members of the Dusan tribe of North Borneo. *Brit. J. Plastic Surg. 15,* 173–181, 1962.

KROGMAN, W. M. and SASSOUNI, V., *A Syllabus of Roentgenographic Cephalometry.* Philadelphia, 1957.

MEREDITH, H. V., A longitudinal study of growth in face depth during childhood, *American Journal of Physical Anthropology 17,* 125–136, 1959.

ORTIZ-MONASTERIO, F., REBEL, A. S., VALDERRAMO, M. and CURZ, R., Cephalometric measurements on adult patients with non-operated cleft palates, *Plastic Reconst. Surg. 24,* 53–61, 1959.

ORTIZ-MONASTERIO, F., SERRANO, A., BARRERA, G., RODRIQUEZ-HOFFMAN, H. and VINAGERAS, E., A study of untreated adult cleft palate patients, *Plastic Reconst. Surg. 38,* 36–41, 1966.

PITANGUY, J. and FRANCO, T., Non-operated facial fissures in adults, *Plastic Reconstr. Surg. 39,* 569–577, 1967.

WELCH, B. L., The generalization of "students" problem when several variance are involved, *Biometrika 34,* 28–35, 1947.