A Cephalometric Study of the Effects of Primary Osteoplasty in Unilateral Cleft Lip and Palate Individuals

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Nine cases with unilateral cleft lip and palate treated with primary alveolar osteoplasty procedures were compared cephalometrically to nine cases with the same type of congenital defect treated with soft tissue surgery and no bone graft. Facial depth and height and maxillary depth and height were studied. The results showed no significant difference in most of the measurements except in the relation of the mandibular apical base to the anterior cranial base, which was distally positioned in the bone-grafted group. The absolute depth of the mandible was found to be significantly less in the bone-grafted group.

KEY WORDS: Unilateral cleft lip, unilateral cleft palate, alveolar osteoplasty, cephalometrics, mandible

There is a great diversity of opinion regarding the effects of primary bone grafting on the growth of the face generally and on the maxilla in particular. Some investigators have reported that primary bone grafting is unnecessary and traumatic and may cause attenuation of the maxillary growth center. Rehrmann *et al.*, (1970) concluded that early bone grafting in nearly all of their cases provoked retardation in the development of the maxillary arch and local growth arrest of the maxillary bone. Thus, they abandoned primary and early secondary bone grafting and limited osteoplasty till the eruption of the permanent dentition. Earlier, Graber (1949) had warned against early surgical intervention because of its detrimental influence on maxillo-facial growth. Other investigators have concluded that primary bone grafting is beneficial to individuals with clefts of the lip and palate (Brauer and Cronin, 1964; Pickrill *et al.*, 1968; Rosenstein, 1975; Rosenstein *et al.*, 1972; and Wood, 1970.)

The purpose of this study was to determine cephalometrically variations in facial proportions and in the maxilla in bone-grafted patients with unilateral clefts of the lip and palate compared to individuals treated without bone grafts. All subjects were evaluated and compared during the early permanent dentition stage, i.e., around thirteen years of age.

Method

The material consisted of lateral cephalometric roentgenograms of eighteen Caucasian children, who had complete unilateral clefts extending through the soft and hard palates, the alveolar process, and the upper lip. The 18 subjects were divided into two groups of nine: Group I consisted of five boys and four girls treated by primary alveolar bone graft. They were the only subjects available out of twelve treated cases over 12 years of age. Their ages ranged from 12 years and two months to 13 years and nine months, with an average age of 13 years. These cases had been treated with primary osteoplasty at the Children's Memorial Hospital, Chicago, Illinois. The sample was made available by Sheldon Rosenstein, D.D.S., M.S.D. The initial surgery consisted of cheiloplasty carried out when the child had regained his birth weight. Prior to, or at the time of lip closure, a prosthetic maxillary appliance was inserted to re-establish, or preserve, the maxillary arch form and symmetry. As described by Rosenstein in 1969, once the buccal segments were aligned, an autogenous rib graft was placed at an age

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ranging from four to 11 months, with an average age of seven months.

Group II consisted of four boys and five girls treated with soft tissue surgery and no primary osteoplasty. They had lateral cephalometric roentgenograms taken within the same age range as group I. They were selected from the files of the Cleft Lip and Palate Institute of Northwestern University, Chicago, Illinois. The process of selection was continued until the nine cases required for the comparison were picked. Their ages ranged from 12 years and seven months to 13 years and 11 months, with an average age of 13 years and two months.

The lateral cephalometric roentgenograms of the two groups were traced by the author and double checked for landmarks and measurements. The following cephalometric landmarks were utilized in this comparison:

Orbitale (Or): The lowest point on the lower margin of the bony orbit.

Porion (Po): Machine registration of the superior-most point of the external auditory meatus.

Nasion (N): The most anterior point of the frontonasal suture as viewed laterally.

Basion (Ba): The median point of the anterior margin of the foramen magnum.

Sella (S): The mid-point of the sella turcica determined by inspection.

Anterior Nasal Spine (ANS): The tip of the anterior nasal spine seen on the lateral X-ray film.

Pterygo-maxillary Fissue (PTM): The projected contour of the fissue with the anterior wall closely approximating the retromolar tuberosity of the maxilla.

Subspinale Point (A): The deepest midline point on the premaxilla between the anterior nasal spine and prosthion.

Supramentale Point (B): The deepest midline point on the bony chin between the infradentale and the pogonion points.

Pogonion (Pg): The most anterior point on the bony chin.

Menton (M): The lowest point on the bony chin.

Articulare (Ar): A strictly roentgenographic landmark. The point of intersection of the dorsal contour of the process articularis mandibular and the os temporale.

Maxillary incisor (*1*): The tip of the maxillary central incisors.

Maxillary first molar (*6*): The tip of the mesiobuccal cusp of the upper first molar.

The following cephalometric lines and planes were constructed on the tracings using a modification of the system suggested by Coben (1955) and Wylie (1947):

The Frankfort Horizontal plane (Po-Or) was used, as in the Coben analysis, as the abscissa.

A perpendicular line from the basion to the Frankfort Horizontal plane was constructed as the Ordinate.

The mandibular plane (MP) was drawn from the Menton tangent to the lower border of the mandible.

The occlusal plane was a line drawn from the tip of the maxillary central incisor to the tip of the mesiobuccal cusp of the maxillary first molar.

The following angular measurements were recorded (Figure 1):

SNA represents the relationship of the maxillary apical base to the anterior cranium.

SNB shows the relationship of the mandibular apical base to the anterior cranium.

ANB represents the difference between the maxillary and mandibular apical bases.

MP-SN relates the mandibular plane to the anterior cranial base.

RI represents the ramal inclination as a deviation from a vertical line drawn perpendicular to Frankfort Horizontal plane at (Ar).

The various depths of the relevant landmarks, as projected on the abscissa, and the vertical heights of the anterior parts of the face, as projected on the ordinate and recorded to the nearest 0.5 mm (Figure 2), are as follows:

The cranium (N-Ba)

The anterior cranial base (S-N)

The maxilla at the orbital level (Or-PTM)

The maxilla at the nasal floor level (ANS-PTM)

The maxilla at the apical level of the teeth (A-PTM)

The posterior part of the face (PTM-Ba)

The mandible (pg-AR)

The total face height (N-M)

The upper face height (N-ANS)

The anterior dental height (*1* - ANS)

The posterior dental height (*6* - Ps): It is measured as the length of a perpendicu-

lar to the occlusal plane erected from the mesiobuccal cusp of *6* to the palatal surface (Ps)

Results

The data obtained from the two groups were recorded. The means, standard deviations, and the range of each group were calculated (Table 1). The student t-test was used to determine if there were any significant differences between the means of the two groups.

Table 2 shows that there was no significant difference in the angular measurements except for the mandibular apical base relation to the anterior cranial base (SNB) and the ramal inclination (RI), where the mean SNB angle for group I was 71.94°, which was significantly less than that of group II, which was 76.56° ($t = -2.61$, $P < .05$). Also, the mean ramal inclination (RI) for group I was 2.9°, whereas it was increased to 8.0° for group II, giving 5.1° greater inclination. This was found to be significantly different ($t = -2.29$, $P < .05$).

Table 3 shows the depth and height measurements used to compare the two groups. There was no significant difference in the depth of the cranium, the depth of the anterior cranial fossa, or the depth of the maxilla

TABLE 1. Means and Age Ranges of the Two Groups in Years and Months

Group	*Mean*		*Ranges*			
	Years	*Months*	*Years*	*Months*	*Years*	*Months*
1	13	00	12	2	13	09
2	13	02	12	07	13	11

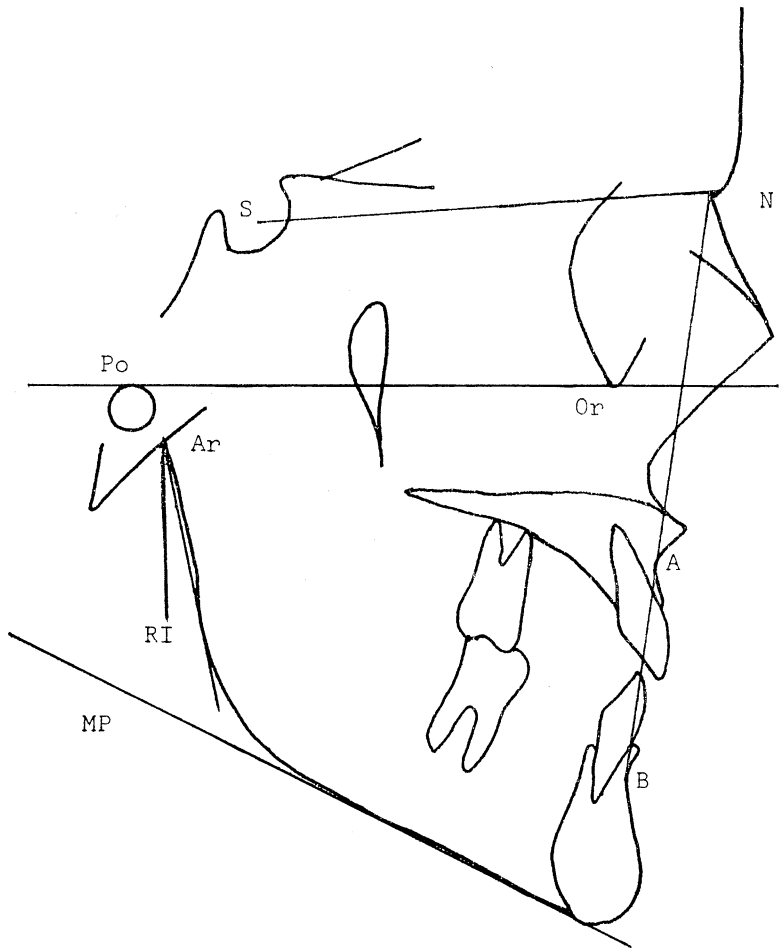

FIGURE 1. The angular measurements used to compare the two groups.

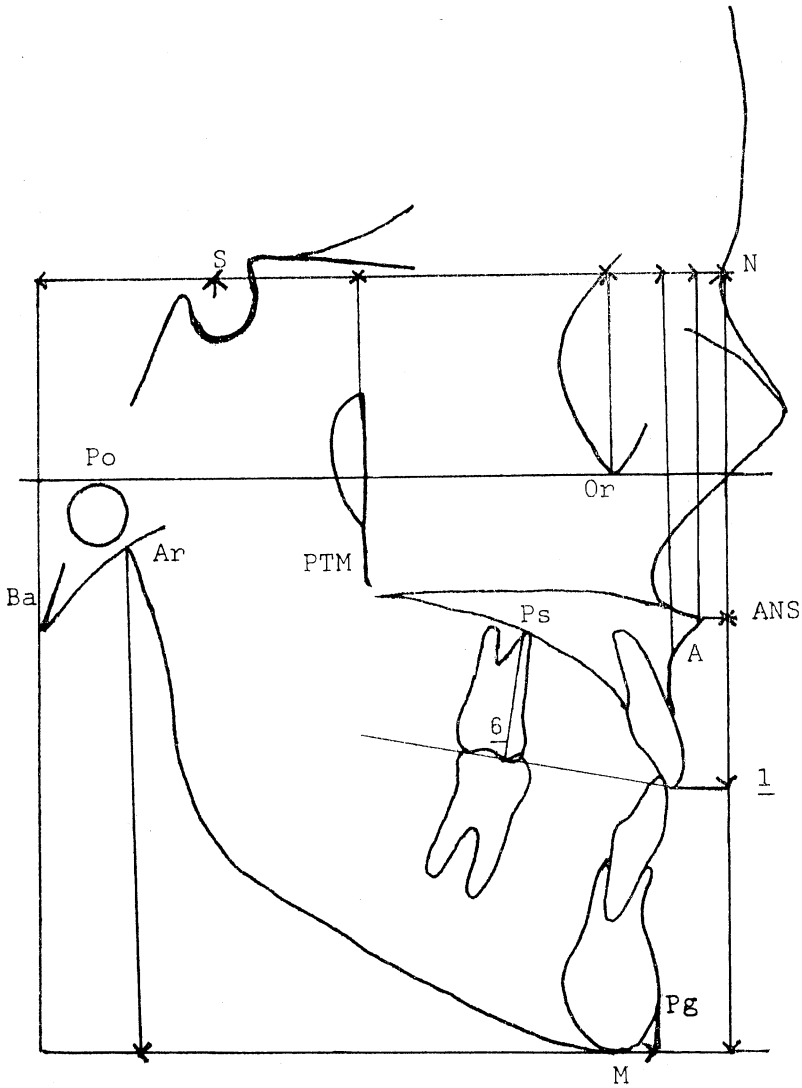

FIGURE 2. Cephalometric measurements for the depth and height of the face.

TABLE 2. Means, Standard Deviations, Standard Errors, and the t-Values of the Angular Measurements Used to Compare the Bone Grafted Group to the Non-Bone Grafted Group

Variables		*Mean*	*S.D.*	*S.E.*	*t-Values*
SNA	Group 1	74.61	3.31	1.10	−0.78
	Group 2	77.44	5.58	1.86	
SNB	Group 1	71.94	3.84	1.28	−2.61*
	Group 2	76.56	3.64	1.22	
ANB	Group 1	2.67	3.31	1.10	0.99
	Group 2	0.88	4.26	1.42	
RI	Group 1	2.90	5.86	1.95	−2.29*
	Group 2	8.00	3.08	1.03	
MP-SN	Group 1	38.67	4.82	1.61	1.24
	Group 2	36.22	3.49	1.16	

* t at the 5% level of significance = 2.12.

TABLE 3. Means, Standard Deviations, Standard Errors, and the t-Values of the Depth and Height Measurements Used to Compare the Bone Grafted and the Non-Bone grafted Group

Variables		*Mean*	*S.D.*	*S.E.*	*t-Values*
N-Ba	Group 1	97.11	6.26	2.09	0.67
	Group 2	94.72	8.65	2.88	
N-S	Group 1	71.11	3.72	1.24	0.66
	Group 2	69.72	5.08	1.69	
Or-PTM	Group 1	36.78	1.46	0.49	−0.669
	Group 2	38.72	8.40	2.80	
A-PTM	Group 1	46.89	3.60	1.20	−0.63
	Group 2	48.00	3.83	1.28	
ANS-PTM	Group 1	52.39	3.78	1.26	−0.49
	Group 2	53.44	5.17	1.73	
PTM-Ba	Group 1	42.61	4.31	1.44	0.585
	Group 2	41.50	3.65	1.22	
Pg-Ar	Group 1	68.44	6.65	2.22	−2.44*
	Group 2	76.89	8.15	2.72	
N-M	Group 1	119.72	4.93	1.64	0.02
	Group 2	119.67	8.28	2.76	
N-ANS	Group 1	52.61	3.60	1.20	0.42
	Group 2	51.78	4.66	1.55	
1-ANS	Group 1	28.00	1.92	0.64	0.08
	Group 2	27.89	3.44	1.15	
6-PS	Group 1	21.00	2.19	0.73	−1.03
	Group 2	21.94	3.83	1.28	

* t at the 5% level of significance = 2.12.

at the three different levels calculated. However, the mean depth of the mandible for Group I was 68.44 mm, while for group II it was 76.89 mm. The difference of 8.45 mm was significant (t = −2.44). When the height measurements were compared, the differences between the two groups were not statistically significant.

Discussion

The effect of reparative surgery on craniofacial growth and development is one of the crucial points to be considered in cleft lip and palate cases. It has been shown by Rosenstein (1975), Rosenstein *et al.*, (1972), and Freide (1978) that there was no attenuation of maxillary growth till school age in their samples. Others who have studied older age groups have shown that these individuals are characterized by retrognathic faces (Graber, 1954; Bishara *et al.*, 1979; Dahl 1970; and Johnson, 1980). Ritsila *et al.*, (1973) and Olin *et al.*, (1974), in their experimental studies, had attributed the diminution of maxillary growth to reparative soft tissue surgery and resulting scar tissue formation. Thus, in this study, no attempt has been made to compare these individuals with congenital defects with normal subjects. Instead, we attempted to determine which procedure would have a a less restricting influence on facial and maxillary growth.

Two cephalometric apparatuses were used, both having a constant distance of sixty inches from the X-ray source to the mid-saggital plane. The film cassette was placed as close as possible to the subject's head in order to control the enlargement factor. Trial cephalometric radiographs were taken for a dry skull by both apparatuses and the difference, if any, between the two was found to be minimal. Of course, there are other variable factors that interplay in such a study. These include different surgeons, inherited growth patterns, variation in surgical techniques, and individual differences.

In both groups, both maxillary and mandibular apical bases were found to be distally positioned if compared to the normal Caucasian standards recorded by Steiner (1953).

The maxillary complex showed no significant differences between groups in either height or depth. Thus, it is not possible to conclude that either procedure produces a

better opportunity for normal growth and development of the maxilla.

In the mandible, the mandibular plane angle, although higher than normal, was not significantly different in the two groups. The mandible was, however, positioned significantly more distally, had markedly decreased ramal inclination and markedly decreased depth in the primary bone grafted group. These findings, while difficult to explain as a result of the differences in treatment, suggest that the direction of condylar growth in the bone-grafted group was predominantly upward instead of upward and backward as is usually expected. Such a growth pattern suggests a partial explanation for the apparent decrease in forward movement of the mandible and the difference in absolute depth and also helps to explain how it was possible for the dental bases to remain in a relatively harmonious relationship to each other in the bone-grafted group.

Although the size of the samples was small, this study suggests the need for a more comprehensive study. Before condemning reparative surgery, it would be interesting to compare operated cleft subjects with nonoperated subjects. Such comparisons would help to determine the effects of surgical interference on the growth of the maxilla and of the face in general.

Summary and Conclusions

Nine Caucasians with unilateral clefts of the lip and palate, treated with primary bone graft of the alveolus, were compared cephalometrically to a similar number of cases treated with soft tissue surgery but no primary osteoplasty.

There were no significant differences between the two groups, except for the following:

1. The mandibular apical base was positioned more posteriorly in the bone-grafted group.
2. The ramal inclination angle was significantly smaller in the bone-grafted group.
3. The absolute depth of the mandible was significantly smaller in the bone-grafted group.

Generally speaking, although these individuals were characterized by retrognathic faces, there was no significant difference in the anteroposterior and vertical growth of the middle face in patients with unilateral cleft lip and palate treated with the two different approaches. In contrast, there were significant differences between the two groups in mandibular depth and position, with mandibles in the bone-grafted group being shorter and more distally positioned. Maintenance of harmonious relationships of the dental bases was, however, achieved.

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