Mandibular Growth in Surgically Repaired Cleft Lip and Cleft Palate Individuals

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The development of the dentofacial complex depends upon the concomitant growth and integrity of associated structures. It is therefore understandable that, if any of these associated structures is deficient in growth, it will have a deleterious effect on the growth of other structures. Thus in the presence of cleft palate deformity other structures of the face such as nasal septum, pharynx and the mandible may also show a deviant morphology. In recent years attention has been directed to the study of the growth pattern of the jaws, especially in cleft palate patients. However, the results of these studies are at variance with each other. Further, there are differing views as to whether cleft palate affects the growth of the jaws adversely and also if the repair of such clefts has a similar effect on growth of the jaws.

It is well-established that cleft palate deformity affects the growth of the maxilla. Not only that, but also the surgical repair of such a deformity further influences the growth of jaws adversely. However, no such definite conclusions are arrived at regarding the growth and development of the mandible in the cleft palate patients. There are still doubts whether the mandible is underdeveloped, overdeveloped, normal, or malposed in relation to other facial and cranial structures.[24,26,27]

It was decided to study by using radiographic cephalometrics the different aspects of mandibular growth in a group of Indian children with surgically repaired cleft palate and cleft lip.

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Review of Literature

Gilley[8] was one of the first to evaluate objectively, the facial deformity in cleft lip and palate individuals and reported a definite increase in the FMA in cleft individuals, which he thought might be due to a short ramus.

Graber carried out four studies.[9-12] In each study the size of the sample was different, i.e., 45, 33, 150 and 175, respectfully, ranging in age from 1 week to 77 years. Only in the fourth study he found "a definite mandibular underdevelopment in individuals with cleft of the lip and palate."

Ponterio[22] reported that the total mandibular length from the condyle to pogonion was much smaller in the cleft group than in that of his controls.

Snodgrasse[29] found evidence of the tendency toward mandibular underdevelopment with more in the female mandible. Higley[13] put more stress on the importance of sex difference in selecting the sample size in his study.

Swanson carried out two studies[30,32] with the sample size of 100 and 164, respectively. His conclusions from both studies were: chin point was retruded, Y axis had a greater mean angle, mandibular plane angle was considerably larger, and IMPA was negative. Levin[18] found GO-Pg, Ba-Pg, Ar-Go, and S-Go significantly shorter in his cleft palate study.

Tong[33] studied 79 cases, divided into two groups, and found normal mandibles in the first group (5.5 to 9.5 yrs.) and significant deficiency in horizontal mandibular length in the second (9.5 to 18 yrs.).

Foster[7] in 200 individuals with cleft found retruded mandibles in relation

to nasion in males and greater anterior mandibular height in female clefts.

Deuschle and Kalter[5] provided the most recent report in which they have found shortening of the anteroposterior mandibular dimension and developmental failure in the vertical mandibular growth, while Borden[3] could not find any difference in growth rate and its pattern between clefts and normal infants.

Osborne[20] studied adult individuals and observed little change in angle Na-S-Gn, while the FH-GO-Me angle was affected by vertical mandibular growth.

Aduss[1] reviewed complete unilateral cleft lip and palate and his findings suggested a tendency toward an elevated anterior cranial fossa coupled with an increased gonial angle reflected in an increased anterior facial height for the cleft group.

Shaikh's[28] study of 15 cleft palate Indian children showed that the chin was retruded in relation to the cranium and the mandible lacked vertical growth, while Kim[17] found no abnormality in mandibular size in his cleft lip and palate group.

Quinn[25] stated mandibular prognathism to be more common in cleft palate/lip due more to lack of soft tissue balance than to the bone on skeletal profile relationship.

Materials and Methods

The material for this study consisted of 25 cleft lip and palate individuals chosen from the files of the Department of Plastic Surgery, Civil Hospital, Ahmedabad and a control group of 25 individuals not having cleft lip and palate taken from patients attending the Department of Orthodontics, Government Dental College and Hospital, Ahmedabad and an additional 25 individuals having normal occlusion of teeth selected from among local school children. All subjects were between 6 and 18 years of age and none had orthodontic treatment. No consideration was given to sex, ethnic group or facial profile. The study group had congenital cleft lips and palates surgically repaired.

Cephalograms were taken of all subjects with teeth in centric occlusion; a bony profile of the mandible was traced using the standard tracing technique. The mean shadow of bilateral structures was traced. All linear and angular measurements were made to the nearest 0.5 mm and 0.5°, respectively. To minimize error in measurements, each cephalometric radiograph was traced three times at intervals of 15 days and the mean value of these three measurements taken for the final data.

Eight angular and eleven linear measurements of the individuals with the cleft lip and palate deformity and of the individuals forming control groups were taken and are given in the tables.

As the size of the sample was 25 in each group, a "t" test was applied for testing statistical significance between different variables, sexes, and age groups at 95% and 99% level with $n_1 + n_2 - 2$ degrees of freedom.

The collected data were computerized to analyze mean, standard deviation and "t" values.

Discussion

Since the anatomist, John Hunter, first studied actual changes in the facial growth systematically, many methods for studying facial growth have been employed. They include vital staining, radioisotopes, implants, comparative anatomy, and radiographic cephalometrics.

In cephalometric radiographs it is difficult to see good definition of certain areas of the skull such as the condyle, point A and anterior nasal spine. It was, therefore, considered that using the

center of the earhole (as represented by the center of the ear rods) would provide a definitive landmark which can be conveniently reproduced for measuring the gonial angle and the ramus height. The earholes are reproduced clearly if the ear rods are accurately positioned with the teeth in centric occlusion, i.e., maximum interdigitation of the teeth and the condyles in the most retruded position in the glenoid fossa. Though this point (P') is considered outside the mandible, with a standardized cephalographic technique the jaw position is not variable and therefore the measurement can be repeated and is reliable.[15]

In those cases of cleft palate where there is associated deformity in the premaxilla, it was difficult to locate point A. According to Jarabak,[16] a point 2.0 mm anterior to the apices of the maxillary central incisors should be considered as point A. This point can be readily identified and duplicated. Besides it more nearly approximates the maxillary denture base than does point A located at subnasale. It is also an area of bone which is directly influenced by orthodontic force applied to the apices of the central incisors. Subnasale, being a midline structure, is often influenced by the head position in the cephalostat and by density of the film. It may be located somewhere between the apical one third and the coronal one third of the roots of the central incisors in cephalograms. In the present study the location of the apex of the central incisors was not difficult as there was no case having midline cleft in the cleft palate group. Even in those cases where the deciduous central incisors were still present, point A was selected in the same way as mentioned.

The review of literature revealed that most of the workers included in their studies individuals with both cleft lip along with cleft palate defects and individuals with cleft palate defect only. It is desirable that the group of subjects having cleft lip and palate should be separated from that having cleft palate only when comparison is to be made. Authors like Fogh-Anderson[6] have stated that these two types of defects, i.e., cleft lip and palate, and cleft palate only are etiological different entities.

Further Fogh-Anderson[6] and Wang[34] have expressed the view that if one part of the body is malformed there is a tendency for other parts also to be malformed. The degree and extent of malformation depends basically upon the differences in the causative factor, the intensity of such a causative factor, and the time of its action. Therefore, if the etiological factor is different in the two types of defects, then it would be reasonable to expect a difference in the type of defects of the associated malformations. Secondly, the surgical management also varies to a certain extent in the two types of defects. Considering this viewpoint, only those subjects having both the defects, i.e., cleft lip as well as cleft palate, were included in the present study.

These cleft lip and palate individuals were compared with two groups of individuals which did not have cleft lip and cleft palate deformity. Of these two groups one had a normal occlusion of the teeth and normal facial profile, and the other group was selected irrespective of the type of dental occlusion and facial profile. This was done because, according to Swanson,[32] many orthodontists consider a "straight" or "slightly concave" profile to be more ideal than a convex profile. It is therefore possible that an ideal normal sample would exclude those individuals with a small or retrusive mandible and include those individuals with a prominent mandible. Thus an ideal normal sample would include subjects with a

larger mean mandibular size than that of a sample selected irrespective of the occlusion or facial profile.

To impress the above-mentioned point, the following observations in regard to the two control groups may be put forward as this study was mainly concerned with mandibular growth in the cleft lip and palate individuals. The measurements from the two control groups when tested by the "t" test showed a significant difference between the measurements of the gonial angle, SNB angle, GoGn-Sn angle, and SL measurements (Tables I, II, III).

The relationship of the anterior limit of the mandibular apical base to the cranial base is denoted by angle SNB. Looking to the mean value, it will be seen that the anterior limit of the mandibular apical base is retruded in the cleft palate group as indicated by the smaller SNB angle. The difference was significant in the affected group, and more so in the younger age group. Even though older individuals did not show a significant difference, the mean values of angle SNB showed a tendency toward a retruded mandible. This finding is in agreement with the findings of Graber,[12] Shaikh,[28] and Foster.[7] However, it is contrary to the findings of Osborne,[20] Levin,[18] and Coccaro[4] who observed in their studies that the mandible was protruded. Osborne carried out a study of adolescent individuals between the ages of 12 to 21 years. His study may have expressed the values of facial growth which takes place after 18 years of age. Levin's findings of 53 individuals with this deformity can be considered, but in his sample the age range was very small, between 7 to 9 years, and he arrived at the above conclusion after comparing the value with the mean values of a noncleft palate group of Coben. Coccaro carried out a longitudinal study but his sample size was 21 and the age group was younger, 6 months to 7 years.

Y axis angle was found to be higher in the cleft palate group. This higher angle denotes that the chinpoint is retruded and the mandible underdeveloped in relation to the cranial base. This finding supports the previous one indicating retruded mandibles. It also showed that the chinpoint remained retruded and the mandible remained underdeveloped until 18 years of age. Thus findings of this study are in agreement with those of Swanson.[30]

Gilley,[8] Swanson,[32] and Shaikh[28] have essentially agreed that FMA is higher in the cleft palate group than in control groups. Vertical growth and height of the ramus of the mandible is shown by FMA. In the lower age group (6-12 years) this angle was significantly higher in the cleft group than the controls. In the higher age group (13-18 years) even though the difference was not statistically significant, FMA was higher in the cleft group. In the combined total sample FMA was significantly higher in the cleft group. This shows that vertical growth of the ramus of the mandible was poor resulting in a short ramus. This finding supports the previous observation (Y axis angle) in this study regarding mandibular growth. In contrast to this finding, Graber[9,10] and Foster[7] have concluded that FMA was within normal limits and that no significant difference was observed. From his first study Graber[10] explained that the slightly more acute angle was because of the overclosure. In his later study Graber[11] concluded that, though the FMA was within normal limits, a tendency toward underdevelopment of the mandible was seen.

Axial inclination of the mandibular incisor to the mandibular plane is denoted by angle IMPA. There was a strong indication of lingual tipping of the mandibular incisors in cleft palate individuals. This tipping of the man-

TABLE - I

SHOWING MEAN, STANDARD DEVIATION AND 't' VALUES OF ANGULAR CEPHALOMETRIC AND LINEAR CEPHALOMETRIC MEASUREMENTS IN DEGREES AND IN MILLIMETERS BY GROUPS.

Variables	Group- I		Group - II		Group-III		t 1/2	t 1/3	t 2/3
	Mean	S.D.	Mean	S.D.	Mean	S.D.	d.f=48	d.f.=48	d.f.=48
S N A	78.7	5.1	82.0	4.0	81.6	3.9	2.51*	2.25*	0.34
S N B	75.8	4.0	78.2	3.4	77.6	4.8	2.30*	1.46	0.49
SN-Ans	83.2	5.3	86.4	4.1	86.4	4.3	2.38*	2.40*	0.06
Y-axis	67.1	4.3	64.0	4.3	64.1	5.1	2.56*	2.30*	0.03
F M A	33.7	6.1	28.7	5.9	26.8	6.2	2.95**	3.93**	1.08
I M P A	89.8	6.4	100.8	8.1	99.2	8.6	5.31**	4.39**	0.69
GoGn-SN	34.9	5.8	30.0	5.2	28.9	5.3	3.14**	3.80**	0.72
Gonial Angle	120.3	5.7	118.7	6.7	114.7	5.4	0.88	3.54**	2.33*
Go Gn	67.8	6.5	69.2	7.7	69.3	6.3	0.71	0.84	0.05
N-Ans	46.8	3.1	48.7	4.0	48.1	5.1	1.93	1.14	0.46
Ans-Gn	63.0	4.6	58.8	5.0	59.0	6.9	3.09*	2.40*	0.13
N-Gn	108.4	7.5	106.0	7.8	106.0	10.4	1.10	0.92	0.01
Y-axis	112.4	9.5	113.5	10.1	112.9	7.8	0.38	0.19	0.23
Go-P'	43,2	6.5	47.1	6.5	47.4	6.4	2.07*	2.30*	0.21
S-P'	31.7	4.7	31.7	4.0	30.8	4.6	0.02	0.68	0.74
S L	47.5	8.1	51.6	8.6	50.0	8.2	1.73	1.10	0.65
S E	18.0	4.0	18.1	3.0	18.5	4.0	0.08	0.47	0.46
S N	67.6	4.1	69.1	3.7	69.0	4.2	1.38	1.19	0.13
Ans-Pns	49.0	4.3	50.7	3.5	50.8	3.4	1.56	1.67	0.08

* Significant at 95% level
** Highly significant at 99% level.
Group - I = Cleft lip and cleft palate individuals.
Group - II = Non cleft lip and cleft palate individuals.
Group-III = Individuals with normal occlusion and normal facial profile.

S.D. = Standard Deviation.
d.f. = Degree of freedom.
Value of 't' at 95% and 99% significant level with 48 degrres of freedom is 2.014 and 2.686 respectively.

TABLE - II

SHOWING MEAN, STANDARD DEVIATION, CO-EFFICIENT OF VARIATION AND 't' VALUES OF ANGULAR CEPHALOMETRIC MEASUREMENTS IN DEGREES AND LINEAR CEPHALOMETRIC MEASUREMENTS IN MILLIMETERS BY AGE GROUP OF 6 to 12 YEARS.

Variables	Group -I			Group-II			Group-III			t 1/2	t 1/3	t 2/3
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	d.f=35	d.f.=28	d.f.=31
S N A	79.1	5.5	7.0	80.5	3.3	4.1	81.6	3.9	4.8	1.63	0.85	0.81
SNB	74.6	3.7	5.0	76.3	2.4	3.2	78.1	4.6	5.9	2.54*	1.46	1.30
SN-Ans	83.5	3.7	6.9	84.8	2.4	4.2	86.5	4.6	5.2	1.77	0.73	1.11
Y-axis	67.0	4.6	6.9	64.1	5.3	8.2	63.4	4.9	7.8	2.31*	1.60	0.43
F M A	34.3	5.3	15.6	29.8	6.5	21.8	26.7	6.2	23.3	3.95**	2.10*	1.36
I M P A	88.5	6.6	7.5	97.8	7.8	8.0	98.7	8.8	8.9	3.90**	3.50**	0.29
GoGn-SN	36.6	4.3	11.8	32.4	4.6	14.1	28.5	5.2	18.3	5.07**	2.55*	2.20*
Gonial Angle	120.6	5.4	4.5	122.0	5.7	4.7	115.2	5.4	4.7	3.08**	0.67	3.47**
Go-Gn	64.9	5.4	8.4	62.9	4.8	7.7	68.4	6.3	9.2	1.79	1.04	2.66*
N-Ans	45.4	2.5	5.5	46.7	3.7	8.0	47.1	4.8	10.3	1.25	1.08	0.25
Ans-Gn	61.8	5.0	8.1	56.3	3.6	6.4	56.9	5.3	9.2	2.88**	3.55**	0.38
N-Gn	105.5	7.1	6.8	101.3	6.5	6.4	103.1	8.6	8.4	0.92	1.68	0.64
Y-axis	107.9	7.7	7.1	106.1	6.5	6.2	110.7	6.5	5.9	1.22	0.68	1.99
Go-P'	41.2	4.7	11.4	44.6	6.2	13.8	46.1	5.8	12.6	2.79**	1.71	0.72
S-P'	30.2	4.6	15.3	29.0	2.9	10.1	30.0	4.3	14.4	0.12	0.80	0.73
S L	44.3	5.6	15.0	46.0	5.4	11.8	51.1	7.3	14.3	2.94**	0.75	2.15*
S E	17.1	3.6	21.0	16.5	2.3	13.9	17.8	3.4	19.1	0.59	0.56	1.22
S N	66.0	3.2	4.8	66.9	2.8	4.1	68.6	4.3	6.3	2.06*	0.86	1.22
Ans-Pns	48.8	4.5	9.3	48.7	2.8	5.8	50.2	3.4	6.8	1.08	0.11	1.39

* Significant at 95% level
** Highly significant at 99% level
Group-I = Cleft lip and cleft palate individuals.
Group-II= Non cleft lip and cleft palate individuals.
Group-III= Individuals with normal occlusion and normal facial profile.

S.D. = Standard Deviation.
C.V. = Co-efficient of variation.
d.f. = Degree of freedom

't' value	Degree of freedom		
	35	28	31
95%	2.03	2.05	2.038
99%	2.72	2.76	2.744

TABLE - III

SHOWING MEAN, STANDARD DEVIATION, CO-EFFICIENT OF VARIATION AND 't' VALUES OF ANGULAR CEPHALOMETRIC MEASUREMENTS IN DEGREES AND LINEAR CEPHALOMETRIC MEASUREMENTS IN MILLIMETERS BY AGE GROUP OF 13 to 18 YEARS.

Variables	Group-I			Group-II			Group-III			t 1/2	t 1/3	t 2/3
	Mean	S.D.	C.V.	Mean	S.D.	C.V.	Mean	S.D.	C.V.	d.f=11	d.f=18	d.f=15
S N A	77.9	4.5	5.7	83.5	4.3	5.1	81.5	4.2	5.2	1.45	2.83*	0.88
S N B	78.5	3.3	4.2	80.3	3.1	3.9	75.7	5.7	7.5	1.11	1.25	2.16*
SN-Ans	82.9	4.7	5.7	88.0	4.1	4.6	86.3	3.6	4.1	1.56	2.83*	0.83
Y-axis	67.4	3.7	5.5	64.0	3.1	4.8	67-0	5.2	7.7	0.18	2.27*	1.52
F M A	32.3	7.6	23.5	27.5	5.2	18.9	27.3	7.0	25.8	1.19	1.69	0.07
I M P A	92.5	5.4	5.9	104.2	7.4	7.1	101.5	8.0	7.9	2.43*	3.81**	0.66
GoGn-SN	31.2	7.2	23.0	27.3	4.6	16.7	30.4	5.7	18.8	0.21	1.49	1.19
Gonial Angle	119.4	6.7	5.6	115.1	5.9	5.1	112.9	5.2	4.6	1.84	1.50	0.73
Go Gn	73.9	3.6	4.9	76.0	2.6	3.4	73.0	5.4	7.3	0.38	1.51	1.61
N-Ans	49.7	2.2	4.4	51.0	3.1	6.0	52.5	2.8	7.3	1.72	1.07	0.86
Ans-Gn	65.6	2.1	3.3	61.5	4.9	8.0	67.5	6.5	9.7	0.78	2.17*	2.07
N-Gn	114.5	3.6	3.1	111.1	5.8	5.2	117.8	8.9	7.6	0.96	1.44	1.85
Y-axis	122.0	4.5	3.7	121.5	6.5	5.4	121.6	6.7	5.5	0.14	0.22	0.04
Go-P'	47.6	7.9	16.5	49.8	6.0	12.1	52.8	6.4	12.1	1.24	0.69	0.94
S-P'	35.0	2.7	7.7	34.7	2.8	8.0	34.2	4.4	12.7	0.42	0.25	0.29
S L	54.2	7.0	12.9	57.6	7.3	12.7	45.7	11.1	24.2	1.72	1.03	2.64*
S E	19.9	4.3	21.7	19.8	2.8	14.1	21.6	5.3	24.5	0.63	0.05	0.91
S N	71.1	3.8	5.3	71.5	3.2	4.5	70.7	3.2	4.5	0.20	0.28	0.50
Ans-Pns	49.4	3.9	7.9	53.0	2.8	5.3	53.2	2.0	3.7	1.98	2.39*	0.14

* Significant at 95% level.
Group - I = Cleft lip and cleft palate individuals
Group - II = Non cleft lip and cleft palate individuals.
Group - III = Individuals with normal occlusion and normal facial profile.
S.D. = Standard Deviation.
C.V. = Co-efficient of variation.
d.f. = Degree of freedom.

't' value	Degree of freedom 11	18	15
95%	2.20	2.10	2.13
99%	3.11	2.88	2.95

**Highly Significant at 99% Level

dibular incisors is considered as a desired compensatory mechanism because the mandibular plane angle is steeper in cleft palate individuals. Thus it actually helps in reducing the apparent mandibular prognathism. Graber and Swanson had observed excessive lingual tipping of the lower incisors which had been attributed to the scars of the upper lip repair as well as perverted function of the entire orbicularis oris complex.

The vertical height of the anterior portion of the mandible and condylar growth area is denoted by angle GoGn-SN. This angle was quite high in children of the cleft palate group. The "t" value also showed a highly significant difference between the cleft palate group and control groups. This observation denotes that the anterior vertical height of the mandible was more in the cleft palate group. With advancing age, though there was no significant difference, tendency toward a higher angle was seen in the cleft palate group.

The mean value of the gonial angle showed that in the cleft palate group it was higher than the two control groups. Bimm[2] and Aduss[1] had concluded that the gonial angle was higher in the cleft palate group.

The anteroposterior length of the body of the mandible is denoted by the GoGn measurement. This did not show any significant difference. It was further observed that with advancing age the anteroposterior length of the body of the mandible approaches normal values. Various authors[1,2,3,5,18,33] found reduction in the length of the mandible. Bimm[2] showed that mandibular length was shorter in cleft palate individuals but with increase in age this dimension approached normal. Our observation coincides with Bimm's findings. The upper facial height is denoted by line N-Ans. It will be seen that the mean value in the cleft palate group is about 1.9 mm less than the noncleft group and about 1.3 mm less than the normal group but the difference was not statistically significant. This shows that the

upper facial height is constant in all three groups. No significant change was observed as the age advanced.

Lower anterior facial height is denoted by the linear distance Ans-Gn. In the cleft palate group this was found to be more than in the other groups. It was shown in the review of literature that in cleft palate there is deficient vertical growth of the maxilla giving a shorter vertical height than noncleft palate and normal groups. Our observation shows that lower anterior vertical facial height is more in the cleft palate group than in the normal group. Our previous observation of the higher GoGn-SN angle in the cleft group confirms that the anterior vertical height of the face is more in cleft palate individuals. Various authors[1,20,21,31] also observed that the anterior vertical height was significantly higher in cleft cases. Foster[7] had observed a sex difference and concluded that the anterior facial height was greater in females.

In the present study on application of "t" test, though significant difference was not observed, the total facial height, N-Gn, was about 2.4 mm more in the cleft group than the other groups. The upper facial height was less while the lower facial height was very much higher in the cleft palate group than control groups; this reflected over the total facial height which became more than in the noncleft and normal groups.

The position of the skeletal chin is denoted by Y axis linear measurement. Mean values in this study demonstrated a greater tendency in the cleft palate group toward a retruded chin. With increase in age there was no significant difference observed, skeletal chin tended to show a little higher mean value in this group. Coccaro[4] stated that with increase in age, skeletal chin tended to become more prognathic; prognathism increased from the 2nd to the 5th year of life, and from the 5th to the 9th year there was a decrease in the rate of prognathism. Osborne[20] demonstrated with SNPg observation that the anterior portion of the mandible was positioned more anteriorly.

Vertical height of the ramus of the mandible is denoted by the linear measurement Go-P'. In the cleft palate group vertical height of the ramus was less, a statistically significant reduction.

Other measurements like Go-Gn and FMA also showed the same results in this study. In the younger age group there was a highly significant difference between the cleft and this control group. In the older age group, though no significant difference was observed, the vertical height of the ramus of the mandible was about 2.2 mm and 5.2 mm shorter than the noncleft palate and normal groups. Levin had found mandibular ramus (Ar-Go) to be shorter in his cleft palate group.

Anteroposterior location of the mandible to the cranial base is denoted by linear measurement SL. In the cleft palate group it was about 4.1 mm and 2.5 mm shorter than noncleft and normal groups, respectively. The other observation used in this study, GoGn, also shows that anteroposterior length of the mandibular body is shorter in cleft palate individuals.

Anteroposterior location of the mandibular condyle to the SN plane is denoted by line SE. This measurement was the same in the cleft as well as noncleft groups, but was slightly less than the normal group. The difference, however, was not significant. In the present study value of the E point on SN plane is doubtful because of the difficulty experienced in locating the mandibular condyle. The validity of this measurement, even though questionable, was analyzed with a view that it may be of some clinical value.

In the present study, even though there was not equal distribution of both sexes (60% males and 40% females), sexwise differences in the observations were analyzed; this showed that females had higher FMA, higher GoGn-SN angles and larger gonial angles than the males among the cleft individuals and the differences were highly significant. Thus females were showing more disturbed growth of the mandible than the males.

One point should be stressed: all the investigators have not used the same methods and measurements for studying the mandible in cleft palates. Moreover, the sample number also varied. Hence the comparison of our findings with those of the other investigators has been done on a very general basis. With this reservation it may be said that the reports of the previous workers about the mandible being underdeveloped and retruded are generally confirmed.

Summary and Conclusions

A cephalometric radiographic cross-sectional comparative study was conducted to investigate mandibular growth in subjects having cleft lip and cleft palate deformity. The material for this study was comprised of 25 subjects with operated cleft lip and cleft palate, 25 subjects not having cleft lip and cleft palate, and 25 subjects having clinically normal occlusion and normal facial profile. The age range was from 6 years to 18 years. The observations in the form of various linear and angular measurements expressing mandibular growth in the anteroposterior and vertical directions were analyzed and statistically evaluated.

Based on these observations, the following conclusions regarding mandibular growth in the cleft lip and cleft palate individuals were drawn:

1. Vertical growth and height of the ramus of the mandible was poor.

2. Gonial angle was high expressing hypofunction of the muscles attached to the angle of the mandible.

3. Anterior upper facial height was almost the same in the three groups.

4. Anterior lower facial height was more in the cleft palate group.

5. Anteroposterior length of the mandible, even though smaller, did not show any significant difference.

6. Greater tendency toward retruded skeletal chin in relation to the cranial base.

7. Mandibular incisors were retroclined and lingually placed in relation to the mandibular plane.

8. The females showed more disturbed growth of the mandible than males.

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References

1. Aduss, H.: Craniofacial growth in complete unilateral cleft lip and palate, *Angle Orthodont.* 41:202-213, 1971.
2. Bimm, J. A.: Cleft palate morphology of the human mandible. *Amer. J. Orthodont.* 46:791, 1960.
3. Borden, G. H.: Mandibular growth in the cleft palate infants. M.S. Thesis, *Univ. of Illinois,* 1953.
4. Coccaro, P. J. and Pruzansky, S.: Longitudinal study of skeletal and soft tissue profile in children with unilateral cleft lip and cleft palate. *Cleft Palate,* 2: 1965.
5. Deuschle, F. M. and Kalter. Observation on the mandible in association with defects of the lip and palate. *J. Dent. Res.* 41:1085-1095, 1962.
6. Fogh-Anderson, P.: Incidence of cleft lip and palate constant or increasing. *Acta. Chir. Scandinav.* 122:106-111, 1961.
7. Foster, T. D.: Some aspects of jaw growth in cleft palate. *Trans. Europ. Orthod. Soc.* 1:12, 1961.
8. Gilley, F. M.: A cephalometric analysis of the developmental pattern and facial morphology in cleft palate. M.S.D. Thesis, *Northwestern Univ.,* 1947.
9. Graber, T. M.: Craniofacial morphology in cleft palate and cleft lip de-

formities. *Surg. Gyne. and Obst.* 88: 359-369, 1949.
10. ———: A cephalometric analysis of the developmental pattern and facial morphology in cleft palate. *Angle Orthodont.* 19:91-100, 1949.
11. ———: An appraisal of the developmental deformities in cleft palate and cleft lip individuals. *Quart. Bull. Northwestern Univ. Med. School,* 23: 153-169, 1949.
12. ———The congenital cleft palate deformity. *J.A.D.A.* 48:375-395, 1954.
13. Higley, L. B.: Cephalometric standards for children 4 to 8 years of age. *Amer. J. Orthodont.* 40:51-60, 1954.
14. Iyer, V. S. and Desai, D. M.: Acceptable deviations in normal dentitions. *Angle Orthodont.* 33:253, 1963.
15. Iyer, V. S. and Lutz, W.: Cephalometric comparison of Indian and English facial profiles. *Amer. J. Phys. and Anthrop.,* 24:117-126, 1966.
16. Jarabak, J. R.: *Technique and Treatment with the Light Wire Technique.* Ed. 1, St. Louis, 1963, The C. V. Mosby Company, p. 146.
17. Kim, Y. H.: A comparative cephalometric study of the relationship of facial structures in normal and cleft palate children. M.S. Thesis, *Univ. of Rochester,* 1958.
18. Levin, H. S.: A radiographic cephalometric analysis of cleft palate patients displaying anteroposterior deformities in the middle one third of the face. M.S. thesis, Northwestern Univ. 1960.
19. Olin, W. H.: Cleft lip and cleft palate rehabilitation. *Amer. J. Orthodont.* 52:126-144, 1966.
20. Osborne, H. A.: A serial cephalometric analysis of facial growth in adolescent cleft palate subjects. *Angle Orthodont.* 30:211-223, 1966.
21. Posen, A. L.: Vertical height of the body of the mandible and the occlusal level of the teeth in individuals with cleft and noncleft palates. *J. Canad. Dent. Assoc.* 24:211-218, 1958.
22. Ponterio, A. E.: A cephalometric appraisal of the facial pattern of children with clefts of the palate as compared with normal children. M.S. Thesis, *Univ. of Washington,* 1952.
23. Pinkerton, C. J., Olin, W. H. and Meredith, H. V.: Cephalometric studies of the mandible in individuals with clefts; Part 1, A review, *Cleft Palate J.* 3:258-267, 1966.
24. Pruzansky, S.: The foundations of the cleft palate center and training program of the University of Illinois. *Angle Orthodont.* 27:69-82, 1957.
25. Quinn, G. W. et al.: Treatment of mandibular prognathism in cleft palate patients. *Amer. J. Orthodont.* 59: 76-86, 1971.
26. Ricketts, R. M.: Present status of knowledge concerning the cleft palate child. *Angle Orthodont.* 26:10-21, 1956.
27. Slaughter, W. B.: Facial clefts and their surgical management in view of recent research. *Plast. and Reconstr. Surg.* 4:311-322, 1949.
28. Shaikh, H. S.: Cephalometric appraisal of cleft lip and palate cases. *J. Indian Academy of Dentistry,* Vol. III, V, 1964.
29. Snodgrasse, R. M.: Heredity and cephalo-facial growth in cleft lip and/or cleft palate patients. *Cleft Palate Bull. Monogr. Suppl. 1,* 1954.
30. Swanson, L. T. et al.: Evaluation of the dental problems in the cleft palate patient. *Amer. J. Orthodont.* 42: 749, 1956.
31. Swoiskin, B. L.: Lower arch form in unilateral cleft palate. *Angle Orthodont.* 27:124, 1957.
32. Swanson, L. T.: A cephalometric evaluation of one hundred patients who had cleft palate repairs. *Cleft Palate Bull.* 5:8-10, 1955.
33. Tong, W. Y.: A roentgenographic appraisal of growth and function of the orofacial structures of operated cleft palate children. M.S.D. Thesis, *Univ. of Nebraska,* 1960.
34. Wang, M. K. H. and Macomber, W. B.: Congenital lip sinuses, *Plastic Reconstr. Surg.* 18:319-328, 1956.