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Craniofacial morphology of Patient with Operated Unilateral cleft Lip and Palate (A cephalometric study)

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Abstract

Background: Growth disorders associated with inborn defects, injuries or surgeries can restrict the development of the palatoalveolar complex and initiate the development of jaw and orthodontic anomalies

Aim of the study: to assess the skeletal craniofacial morphology of patients with operated unilateral cleft lip and palate

Materials and Methods: lateral cephalometric radiographs were taken for 20 adult of Iraqi operated unilateral cleft lip and palate patients. Twelve angular measurements and seven linear measurements were compared with control group selected on the bases of satisfactory facial esthetic matching with age.

Results: A significant differences were observed between cleft patients and non cleft individuals in that, cleft patients have smaller mean value mandibular angular measurements max-mand angle, N-S-GN angle with short body length while the maxilla demonstrates a retrusive position and results in the concave profile appeared by increase N-A-Pog angle at $p<0.05$, there is a definite decrease in overall mid facial growth especially in sagittal plane, while the lower anterior facial height shows an increase in length with significantly smaller mean value.

Conclusion: that cleft patients have a craniofacial morphology characterized by retruded maxillomandibule complex with a concave profile, when superimposed on that of control group, and smaller anterior cranial length together with shorter mandibular body result in relatively normal spatial mandiblular position through normal S-N-B angle.

Keywords: unilateral cleft and palate, craniofacial morphology, skeletal cephalometric analysis

Introduction

Cleft is one of the most major congenital defects with considerable racial variation its about 1.5 times higher in Asian populations, .Unilateral cleft lip and palate is the most frequent human cleft, representing 33% of such deformities. It may arise due to failure of fusion of medial , lateral nasal and maxillary process or fusion followed by partial or total break down between the facial processes with continued facial growth[1].

Cephalometric studies have shown that there are well-known differences concerning facial relationships in cleft and non cleft individuals. These differences can be attributed to: (1) the management of the lip and/or palate, (2) functional changes resulting from the mechanical presence of the cleft, (3) genetic pattern, or (4) a combination of these factors[2].

Most persons with cleft lip and /or palate are operated on infancy and/or early childhood. After palatal repair, the palate has an altered shape[3] and the primary growth deficiency of the maxilla can not be ignored ,the dentoalveolar arch and palate are narrow and short ,as a consequence, insufficient space of the tongue, which presses the mandible inferiorly and into a posterior rotation this leads to an open bite occasionally, with impaired vertical intermaxillary relation that are difficult to be corrected by orthodontic therapy [4,5].

During recent years there has been a growing demand for extended roentgeno cephalometric control material , two major reasons for this need have been the refinements in syndrome identification and the advances in craniofacial surgery[6].

The procedure of cleft closure varies considerably among surgeons, timing ,methods and techniques. Various technique are used such as Tennison's , Widmaier and Veau tow stage operation ,Veau's pedicle flap in one stage operation and Malek technique in single operation[5,7].

There is strong correlation between the time of the operation and the course of the deformity, as well as a strong positive correlation existed between growth disturbances and technique employing compression closures[8].

The use of cleft lip and palate patients to provide "normative" data is not new, many studies had been carried out to define the craniofacial deformity for operated patient with unilateral cleft lip and palate[9], most of them found that those patients had a concave profile, retruding maxilla and the mandible appeared to be retrusive.

Graber[10] found that the patient who had been operated in early life showed deviation in the vertical and anteroposterior development of the maxilla.

The management of the patients with orofacial cleft is challenging. Ideally treatment should involve a multidisciplinary approach including, but not limited to, a pediatrician, oral and maxillofacial surgeon, plastic surgeon, otolaryngologist, pediatric dentist, orthodontist and prosthodontist, and speech therapist[11].

Materials and method

The sample of this study consisted of 20 patients 9 males and 11 females whom attended the cleft lip and palate and orthognathic center at the orthodontic department of the college of dentistry, University of Baghdad, and from the maxillofacial department of Al- Kadhimya teaching hospital in the Capital.

Selection criteria

1. The patients are adults and have unilateral cleft lip and palate.
2. Lip repair was carried out during infant.
3. Palate closure occurred during early child hood.
4. There is no marked facial asymmetry rather than the maxillary complex.
5. There are no other anomalies.

The other group, control, consisted of 20 adult patients, their selection based on the following criteria's:

1.The sample is selected on the bases of satisfactory facial esthetic matching with age.
2. There is no marked facial asymmetry.
3. There is no systemic abnormality.
4. Full complement of permanent teeth.
5. There is no history of orthodontic treatment.

Cephalometric radiograph

Lateral cephalometric radiograph were made with the patient teeth in occlusion. Then the out line of the external and internal contour of the cranium, nasal bone and nasofrontal suture, orbit, maxilla, mandible, upper and lower first molars and incisors are traced.

The following landmarks and planes and angles are used[12-14]:

1. Skeletal Landmarks:

S	Mid point of the hypophysial fossa.
Or	The lower most point of the orbit in the radiograph.
Po	The most superior point of the external auditory meatus
A	The most posterior point in the outer contour of the maxillary alveolar process in the median plane. (Corresponding to the upper central incisor apex).
B	The most posterior point in the outer contour of the mandibular alveolar process in the median plane.
Pog	The most anterior point of the bony chin in the median plane.
Is	Tip of the crown of the most anterior maxillary central incisor.
Ii	Tip of the crown of the most anterior mandibular central incisor.
ApIs	Root apex of the most anterior maxillary central incisor.
ApIi	Root apex of the most anterior mandibular central incisor.
Go	A constructed point, constructed by the intersection of lines tangent to the posterior margin of the ascending ramus and the mandibular base.
Me	The most caudal point in the outline of the symphysis,it regarded as the lowest point of the mandible.
N	The most anterior point of the nasofrontal suture in the median plane
Ar	The point of intersection of the posterior margin of the ascending ramus and the outer margin of the cranial base.
ANS	The tip of the bony anterior nasal spine in the median plane.
PNS	The intersection of continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose.
Gn	The most anterior and the most inferior point of the chin

2. Linear measurements:

- ***S-N***: Anteroposterior extent of anterior cranial base.
- ***Me-Go***: Extent of mandibular base.
- ***S-Go***: Posterior facial height.
- **ANS-PNS**: Extent of maxillary base.
- ***N-Me***: Total anterior facial height.
- ***N-ANS***: Middle anterior facial height.
- ***ANS-Me***: Lower anterior facial height.

3. Angular measurements:

- **S-N-A:** The angle defines the anteroposterior position of the

maxilla relative to the anterior cranial base

- **S-N-B:** It determines the anteroposterior position of the mandible in relation to the anterior cranial base.
- **FH-mand angle:** This angle is formed by the intersection of the Frankfort horizontal plane and a tangent to the lower border of the mandible[15].
- **N-A-Pog(angle of convexity):** This angle is formed by the intersection of two lines: nasion to A, and pogonion to A, where A is subspinale , the deepest midline point of the premaxilla
- **1-S-N:** This angle formed by the upper incisor and the S-N ,it is approximately 90 degree posteriorly
- **1¯-mand:** This angle formed by the lower incisors and the lower border of the mandible posteriorly and it is approximately 90 degree**.**
- **N-S-Ar (Saddle angle):**Is the angle between the anterior and posterior cranial base, within the region of the posterior cranial base lies a sagittal growth center ,the sphenooccipital synchondrosis**.**
- **Ar-Go-Me (Gonial angle):** Is an expression for the form of the mandible, with reference to the relation between body and ramus**.**
- **S-Ar-Go (Articular angle):** It is the angle between upper and lower posterior facial height.
- **Max-Mand angle (Basal plane angle):** This angle defines the angle of inclination of the mandible to the maxillary base.
- **N-S-Gn (YAxis):** This angle determines the position of the mandible relative to the cranial base.
- **FH-S-N angle:** This angle formed by Frankfort horizontal plane and S-N plane.

Statistical analysis:

The collected data analyzed to find out the descriptive statistics, including the mean and the standard deviation, and the inferential statistics include the student t-test between the two groups .

Results

Referring to Table 1, the cranial base angular measurements between cleft group and non cleft individuals shows no significant differences.

While Table 2 demonstrates the comparison of angular facial profile measurements between cleft group and normals, it reveals that there were no significant differences except in basal plane angle(max-mand angle),and1-S-N angle ,which are significantly smaller in cleft group, on the other hand, the N-S-Gn (Y-axis), S-N-FH and N-A-Pog angles are significantly larger in cleft group.

Table 3 demonstrates that the cleft group have smaller mean value for the anteroposterior linear measurements S-N and Go-Me at $P<0.05$.

On the other hand, there are smaller linear vertical measurements of N-Me, S-Go ,Ar-Go, N-ANS for cleft patients at significant level

Discussion

Many cephalometric studies [4,7,10] have dealt with the craniofacial morphology of patients with cleft lip and palate, but no previous studies have been carried in Iraq, so this study considered the first study provides information describing the craniofacial morphology of Iraqi patients with operated unilateral cleft lip and palate.

A number of investigators do not register a sex influence in unilateral cleft lip and palate for most of the facial structures[16]. Hence, the whole sample is considered as on group when compared with the non cleft group.

The mandible had almost a normal relation to the anterior cranial base, this explained by the similar SNB angles in both groups; the shorter mandibular length (Go-Me) is balanced by the proportionally shorter anterior cranial base length (S-N), denoting growth equivalents between mandible and anterior cranial base in subjects with cleft lip and palate. This result comes in agreement with da Silva et al[17]and Silva Filho et al[18] who reported that the structure and spatial position of the mandible are not influenced by surgical procedures.

Regarding the Y-axis, this angle showed a significantly increased mean value (71.7**)** than those of control group (66.2). The assumption is valid that the chin point occupied a retruded position in the facial profile which suggested some sort of backward type of growth "clockwise rotation of the mandible" this finding agreed with Dahl[19] and Bishara et al[20,21]. This issue result in increase in anterior growth of the face especially the lower anterior facial height, a fact supported by Graber[10] and Balkhi[22] who concluded that the mandible had slight posterior rotation and showed signs of a vertical growth pattern. On the other hand Swanson[4] suggested that the mandible exhibits a compensatory growth pattern to the reduced maxillary growth caused by the cleft defect.

The body of the mandible (Go-Me), in cleft patients exhibited smaller value at P<0.05,besides that the gonial angle (Ar-Go-Me), had a greater mean value, however it was not reach the significant level i.e. the cleft patients had steeper mandibular plane, this finding supported by the finding of Corbo etal[7], Dahl[19]Jhonson[23].

The upper jaw was affected most apparently by the defect and showed a retrognatic position. Surprisingly, the A-N-B angle(1.8) remain within the normal range but showed a reduced mean value than that of control group, this result supported by Graber[10] who suggested a specific anteroposterior maxillary deficiency with retrognathia accords.

The maxillary mandibular plane angle showed a decreased mean value at p<0.05 in cleft patients. Accordingly when the mandible rotated posteriorly, the maxilla declined and followed the mandibular growth pattern keeping the normal relation i.e. compensate the vertical growth of the mandible, this result coincides with the finding of Gorbo etal [7]and Jhonson[23].

The results of the measurements of the jaws showed that the maxilla and the mandible were retrusive, when superimposed on that of the non cleft individuals[20] i.e. there was a backward rotation of the maxillomandibular complex,shortening of the maxillary depth (ANS-PNS) and diminished mandibular growth (Go-Me) and so there is limitation of anterior growth in cleft patients ,similar results was found by Gorbo etal [7]and Graber [10].

Cleft patients characterized by concave profile which is witnessed in regard to the angle of convexity (N-A-Pog), it is larger significantly than that of control group this is properly due to the retrusive maxilla relative to anterior cranial base in cleft patients, which agreed with several authors[8,10,24].

The morphologic disturbances in the cleft region and in tissue immediately contiguous to the cleft had a bizarre effect on incisors teeth position, besides, scars of the repaired lip lead to more lingual position of the upper incisors teeth in cleft patients, this explained the more acute 1-S-N angle with a significant difference in cleft patients and the upper incisors locked the lower incisors in lingoversion posture, which was confirmed by Swanson et al [4], Gorbo et al [7]and Graber [10].

Referring to the tables 2-4, both the sagittal and anteroposterior parameters suggested a definite decrease in over all mid facial growth. The anterior facial height greatly affected in such a way that there is an increase in the lower facial height in relation to the middle one in a ratio of 55/45.While in non cleft individuals the ratio is 47/53 .Gaggle etal[5], Corbo etal[7] and Graber[10] found that there was increased lower anterior facial height of cleft patients due to relatively high position of anterior nasal spine

On the other hand, there is proportional reduction in the dimensions of the posterior facial heights (S-Go) which, in conjunction with more obtuse gonial angle and downward and backward rotation of the mandible, preserve the normal position of the mandible in relative to the cranium[17].

The 1^{-}-S-N angle showed a non significant smaller mean value when compared with that of non cleft individuals, the impaired lips function and jaws relation participate in this appearance.

The anterior cranial base length showed a smaller mean value at $p<0.05$, this indicates low grade growth rate that may have a direct influence on the proportional length of the maxilla and mandible and their relative position to the cranium. The S-N line showed more obtuse angle with Frankfurt plane when compared with that of non cleft individuals. The aberrant growth of the maxilla in addition to the previously mentioned issues about the relative normal maxillomandibular relation indicate downward and backward rotation of the maxillary complex including the orbit ,thus Frankfurt plane declined downward at orbitale. A fact supported by the non significant difference in saddle and articular angle that indicate harmonious growth, although in low grade, between the anterior and middle cranial base which is confirmed with Cronin and Hunter[25] and Toranzo et al[26], as the former concluded that there was very little difference in cranial morphology between the twins in each group

Conclusion

1. The cranial base has the similar angular measurements in cleft and non cleft individuals and indicate normal relation and compatible growth pattern between the anterior and posterior cranial fossa; however, the growth of the anterior cranial fossa was apparently diminished.
2. Most of the linear measurements are significantly smaller in cleft patient that demonstrate an overall growth alteration.
3. The mandible has normal anteroposterior relation with slight clock wise rotation and possesses some sort of vertical compensatory growth.
4. The maxillary complex actually is affected by hypoplasia it has a retruded position and follows the mandibular growth pattern which result in the concave profile of the face.
5. The affected premaxilla has more superior position and results in alteration in the vertical proportions of the anterior facial height.

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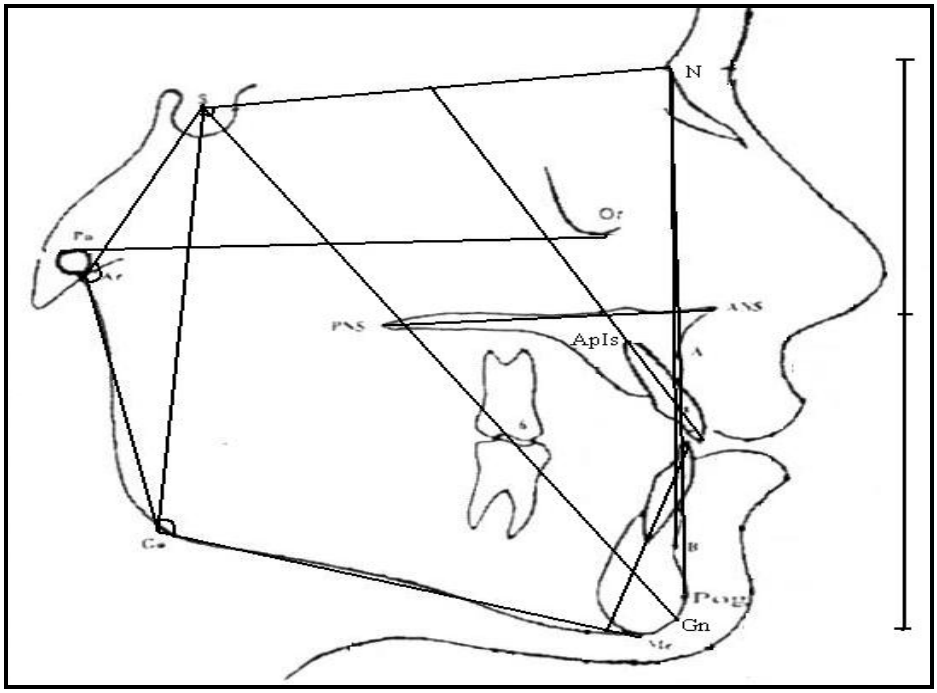

Figure 1: Cephalometric planes and angles

Table 1: Comparison of the cranial base angular measurements between cleft and non cleft individuals

Variable	Cleft		control		t-value	p	Sig.
	Mean	S.D	Mean	S.D			
S-Ar-Go	142.2	3.5	144.6	5.8	-1.236	0.229	NS
N-S-Ar	121.5	5.0	123.0	1.3	-1.043	0.308	NS
S-N-A	79.1	4.2	81.5	0.8	-0.673	0.068	NS
S-N-B	77.3	2.9	77.8	0.8	-0.058	0.954	NS

Table 2 Comparison of the facial profile angular measurements between cleft and non cleft individuals

Variable	Cleft		control		t-value	p	Sig.
	Mean	S.D	Mean	S.D			
Me-Go-Ar	136.0	3.2	132.4	1.7	-0.180	0.859	NS
N-S-Gn (Y-axis)	71.7	6.4	66.2	3.0	2.699	0.013	S
Max-Mand	20.7	3.4	25.0	0.7	-4.272	0.001	S
FH-Mand	27.2	3.9	25.1	0.8	0.937	0.359	NS
S-N-FH	11.0	3.2	9.3	0.6	3.962	0.014	S
N-A-Po	188.7	4.4	171.3	5.6	5.060	0.000	S
1-SN	90.5	8.0	101.3	7.4	-3.413	0.009	S
1^{-}- Mand	88.7	4.8	90.9	2.8	-0.155	0.878	NS

Table 3: Comparison of the anteroposterior linear measurements between cleft and control group

Variable	Cleft		control		t-value	p	Sig.
	Mean	S.D	Mean	S.D			
S-N	61.61	2.54	72.95	3.37	-9.301	0.000	S
Go-Me	65.76	4.21	71.93	5.21	4.587	0.000	S
ANS-PNS	44.32	3.09	48.58	4.60	-1.135	0.269	NS

Table 4: Comparison of the vertical linear measurements between cleft and control group

Variable	Cleft		control		t-value	p	Sig.
	Mean	S.D	Mean	S.D			
N-Me	108.52	4.5	122.9	6.5	-3.44	0.033	S
S-Go	70.65	5.35	76	5.2	-4.27	0.000	S
N-ANS	48.7	5.3	65	4.8	3.92	0.005	S
ANS-Me	59.8	4.2	56.9	5.1	5.21	0.734	NS