SKELETAL OPEN BITE-CEPHALOMETRIC CHARACTERISTICS USING QUADRILATERAL ANALYSIS

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ABSTRACT

Introduction: The aim of this study was to determine the Cephalometric characteristics of skeletal openbite using the quadrilateral analysis to Pakistani male and female patients with anterior open bite and to compare the male and female open bite subjects. **Methodology:** The total sample comprised of 80 pretreatment lateral Cephalometric radiographs, seeking treatment in the dept. of orthodontics, Lahore Medical & Dental College, Lahore. **Results:** Mean age of the study sample was 17.5 years. Maxillary and mandibular base lengths were significantly smaller in open bite patients. However, the anterior facial height, < Sag, < UF, MxE, MnE, (MaxL+MaxE)/MaxE were greater in open bite patients for both genders. ODI was larger in female open bite patients as compared to males. **Conclusion:** Maxillary and mandibular base lengths are smaller in open bite patients than normal occlusion patients. Female openbite sample subjects had a convex profile while males had a straight profile.

Keywords: quadrilateral analysis, anterior openbite, Cephalometric characteristics

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INTRODUCTION:

The quadrilateral Cephalometric analysis was introduced by DiPaolo[1] to recognize the characteristics of maxillary and mandibular skeletal bases in the Sagittal and vertical dimensions. He suggested that a one-to-one ratio exists between the maxillary base length, the mandibular base length and the average of anterior and posterior facial heights in a balanced facial pattern.[1-5] Tseng[6] and Kao et al[7] also advocated that the quadrilateral analysis is a valuable Cephalometric tool for diagnosis and treatment planning of orthodontic problems.

An anterior open bite is a lack of contact between the incisal edges of the maxillary and mandibular anterior teeth in vertical dimension.[8] It is one of the most prevalent malocclusion that may develop in the primary or mixed dentition age as a consequence of an interaction of both genetic and environmental factors.[9,10, 11,12,13] Skeletal open bite is characterized by small anterior cranial base, steep cranial base angle, increased mandibular plane angle and lower face height and a short posterior face height.[14,15-20] On clinical examination, skeletal open bite is manifested by an outsized interlabial gap.[21] Understanding the differences in craniofacial structures between normal and open bite is important for clinical management and research purposes.[22] Skeletal open bite is one of the most difficult orthodontic problems to treat.[23,24] A wide range of treatment methods are in practice for this orthodontic problem.[25, 26,27, 28, 29]

The prevalence of anterior open bite varies among ethnic groups, age and dentition.[30] In observation of this fact, the current study was done in our region to evaluate the characteristics of skeletal open bite using quadrilateral analysis.

PURPOSE OF THE STUDY:

To determine the Cephalometric characteristics of skeletal open bite using the quadrilateral analysis and to compare the male and female skeletal openbite subjects.

MATERIALS AND METHODS:

The current study was carried out on a total sample of 80 selected pretreatment lateral Cephalometric radiographs-20 male and 20 female with normal occlusion and 20 male and 20 females with anterior openbite, seeking treatment in the dept. of orthodontics, Lahore Medical & Dental College between 2005 to June 2009. The Cephalometric radiographs were traced by hand on an acetate sheets

by the same person. Following was the selection criteria:

1) Age range 15-20 years

2) Anterior openbite of 1mm or more- measured as perpendicular vertical distance from the tip of the mandibular incisal edge to the horizontal line passing through the tip of the upper incisal edge in centric occlusion

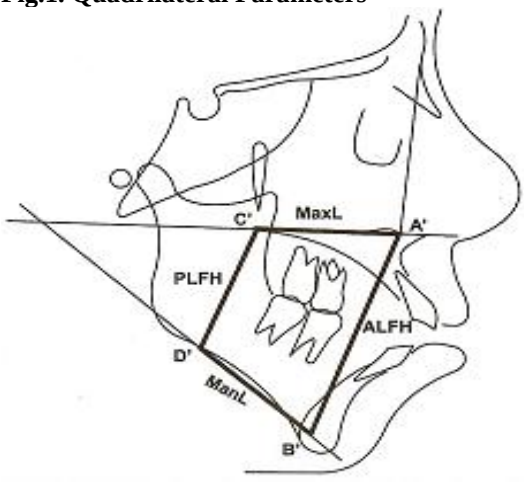
3) Overbite depth indicator (ODI) of less than 68^0

CEPHALOMETRIC PARAMETERS:
Following Cephalometric measurements were used for the study:

Maxillary base length (MaxL), Mandibular base length (Man L), Lower anterior facial height (LAFH), Posterior lower facial height (PLFH), Ratio of anterior to posterior lower facial height (LAFH/PLFH), Total anterior facial height (TAFH), Total posterior facial height (TPFH), Ratio of upper anterior facial height to total anterior facial height (AUFH/TAFH), Ratio of anterior lower facial height to Total anterior facial height (LAFH/TAFH), Ratio of total posterior facial height to Total anterior facial height (TPFH/TAFH), Average of lower anterior facial height to lower posterior facial height (LFH average), Sagittal angle (< Sag), Upper facial angle (< UF), Angle of facial convexity (< FC), Anterior upper facial height (AUFH), Maxillary Sagittal ratio (MaxL+MaxE/MaxE), Mandibular Sagittal ratio (ManL+ManE/ManE), Maxillary extension (MaxE), Mandibular extension (ManE), ratio of maxillary base length to mandibular base length (MaxL/ManL), Ratio of maxillary base length base length to lower facial height average (MaxL/LFH average), Ratio of maxillary posterior extension to mandibular posterior extension (MaxE/ManE) and Overbite depth indicator (ODI).

STATISTICAL ANALYSIS:
The database of study sample measurements was developed in SPSS version 10 for the Windows. 40 radiographs were selected randomly and retraced after 2 weeks of initial tracing and paired t-test was applied to find any method error. The arithmetic mean, range and standard deviation for all the concerned variables were determined using the above-mentioned software. Normal and open bite patients were tested by student's t-test. Independent t-test was applied to compare the male and the female openbite sample subjects.

Fig.1. Quadrilateral Parameters



RESULTS:
The mean age of the total sample was 17.5 years. There was no statistically significant difference recorded between the first and the second tracings on applying the paired t-test for calculation of the method error.

The maxillary and mandibular base lengths were significantly smaller in open bite patients in both male and females. On contrary, the LAFH, TAFH, TPFH, LAFH/TAFH ratio, < Sag, < UF, MxE, MnE, MaxL+MaxE)/MaxE, in both male and female openbite subjects were larger than the normal occlusion group. However, the < FC was lesser in females and almost same in males with open bite in comparison to normal occlusion subjects. The ratio LAFH/LPFH did not show any significant difference. MaxL/LFH avg and ODI values for open bite sample was significantly lesser in openbite subjects than the normal occlusion subjects. (Table 1)

GENDER DIMORPHISM:
On comparing the male with female open bite patients, it was found out that females showed a significant smaller maxillary and mandibular base length than those of males. However the LAFH, LPFH in male open bite subjects was significantly greater than females. The same was true for the values of TAFH, TPFH, < Sag, < UF, MaxE, ManE, (MaxL+MaxE)/MaxE, (ManL+ManE)/ManE, MaxL/LFH avg. Incontrary to this, LAFH/TAFH, TPFH/TAFH was greater in females. < FC in males was almost same in open bite and normal occlusion subjects, while openbite females showed a lesser angle indicating a convex profile than the openbite male subjects. ODI was significantly
greater in females. (Table 2)

Table 1. Quadrilateral Cephalometric analysis of male and female sample subjects

N=80	Male				Female			
Parameters	**Control** (N=20)		**Openbite** (N=20)		**Control** (N=20)		**Openbite** (N=20)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
MaxL	48.2	2.59	45.2	2.89*	45.99	1.92	43	2.5*
ManL	48	2.87	43.1	2.99*	43.17	3.04	40.1	3.18*
MaxL/ManL	1.2	0.08	1.1	0.08	0.9	0.06	1.01	0.09
LAFH	56.6	4.39	65.5	4.60*	53.24	3.73	62.2	4.19*
LPFH	41.5	3.1	43.08	3.20*	38.79	2.81	39.4	3.5*
LAFH/PLFH	1.3	1.12	1.3	1.12	0.91	0.12	1.1	0.09
TAFH	111.6	4.68	117.7	4.79*	103.5	4.56	112.7	5.76*
TPFH	74.8	4.59	69.7	4.62	72.8	4.54	69.3	4.32*
TPFH/TAFH	0.63	0.04	0.53	0.04	0.68	0.04	0.6	0.03
ALFH/TAFH	0.41	0.01	0.43	0.01	0.49	0.02	0.53	0.02
AUFH	49.27	2.37	50.3	2.45	49.65	49.93	50.2	3.04
AUFH/TAFH	0.45	0.01	0.4	0.01	0.45	0.01	0.42	0.02
< Sag	21.8	6.09	31.6	6.15*	20.34	4.90	30.1	4.41*
< UF	88.8	4.49	92.1	4.91	84.43	3.73	85.3	2.98*
< FC	167.7	6.57	167.8	1.67	166.6	4.19	163.6	5.51*
MaxE	125.9	17.62	81.89	18.76*	113.3	29.13	77	14.7*
ManE	124.6	19.25	83.6	20.25	106.8	29.11	74.8	15.86*
MaxE/ManE	0.98	0.03	0.97	0.03	1.07	0.05	0.98	0.09
(MaxL+MaxE)/MaxE	1.29	0.12	1.39	0.12	0.98	0.11	1.1	0.09
(ManL+ManE)/ManE	1.39	0.12	1.49	0.12	1.12	0.12	1.2	0.09
MaxL/LFH avg	0.93	0.07	0.83	0.07	0.94	0.06	.82	0.07
ODI	73.82	4.78	59.45	4.54	73.01	4.74	60.2	4.54*

Table 2. Comparison of Male and Female sample subjects with open bite

Parameters N= 40	**Male** (N=20)		**Female** (N=20)		**Mean Diff.** * P<0.05
	Mean	**SD**	**Mean**	**SD**	
MaxL	45.2	2.59	43	2.5	2.2*
ManL	43.1	2.87	40.1	3.18	3*
MaxL/ManL	1.1	0.08	1.01	0.09	0.9
LAFH	65.5	4.39	62.2	4.19	3.3*
LPFH	43.08	3.1	39.4	3.5	3.68*
LAFH/PLFH	1.3	1.12	1.1	0.09	0.2
TAFH	117.7	4.68	112.7	5.76	5
TPFH	69.7	4.59	69.3	4.32	0.4
TPFH/TAFH	0.53	0.04	0.6	0.03	-0.07
ALFH/TAFH	0.43	0.01	0.53	0.02	- 0.01
AUFH	50.3	2.37	50.2	3.04	0.1
AUFH/TAFH	0.4	0.01	0.42	0.02	- 0.02
< Sag	31.6	6.09	30.1	4.41	1.5
< UF	92.1	4.49	85.3	2.98	6.8*
< FC	167.8	1.67	163.6	5.51	6.2*
MaxE	81.89	17.62	77	14.7	4.89*
ManE	83.6	19.25	74.8	15.86	8.8*
MaxE/ManE	0.97	0.03	0.98	0.09	- 0.01
(MaxL+MaxE)/MaxE	1.39	0.12	1.1	0.09	0.29
(ManL+ManE)/ManE	1.49	0.12	1.2	0.09	0.29
MaxL/LFH avg	0.83	0.07	.82	0.07	0.01
ODI	59.45	4.78	60.2	4.54	- 0.75

DISCUSSION:

The results of the quadrilateral analysis of the anterior openbite in the present study were found to be consistent with results of several other investigators.[2,3,7,13-18,22-24] The morphology of craniofacial pattern presented shorter maxillary base length, increased sagittal angle, average lower facial height, and maxillary and mandibular sagittal ratio. If there is an increase in anterior openbite tendency, the difference of maxillary and mandibular base lengths with average lower facial heights also increases. It comes into view that the malformation of the craniofacial structures in openbite patients resides in the maxillo-mandibualr complex. This is consistent with the findings of numerous other orthodontists.[11-19,22-24]

The lengths of the maxillary and mandibular base were smaller in the open bite group in both genders than those of normal occlusion group. DiPaolo et al,[2] Chinappi,[3] DiPaolo and coworkers,[4,5] and Kao et al[7] also found the same in their study. The lower facial height was found out to be significantly larger in open bite sample subjects, while the lower posterior facial heights were similar in the openbite and normal occlusion subjects. This increase in lower anterior facial height caused in an increase in ratio of lower anterior to posterior facial height. As a consequence, an increase in sagittal angle was noted. The same was reported in numerous other studies.[2-5,7,11-19] The upper facial angle of anterior open bite subjects was found out to be large as compared to normal subjects, thus indicating a retruded maxilla. Similar findings were established by a number of other researchers.[7,12-14]

The facial convexity angle in anterior open bite male subjects was same to those of normal occlusion patients. However, the females with anterior open bite revealed a smaller facial convexity angle. Thus the males with anterior openbite had a straight profile whereas the females exhibited a convex facial profile. The same was true in a study conducted by Cangialosi[13] and Nanda.[23]

Although there are morphologic differences that distinguish males from females, however, the overall measurements of this study did not show a significant gender dimorphism for most of the findings. These observations are steady with quite a few other researchers.[15,16,19,23]

On comparing the male and females with anterior open bite indicate, most of the parameters were found out to be greater in males than in females. However, the females showed a greater ratio of the TPFH/TAFH, LAFH/PLFH, and ODI. Similar findings were specified by few other investigators.[12,13,19]

The average lower facial height was almost equal to the maxillary or mandibular base length in quadrilateral analysis of normal occlusion subjects. However these findings vary in the anterior open bite patients. ODI exhibit significant association with maxillary length and average lower facial height. The maxillary and mandibular base and average lower facial height show definite differences in cases of skeletal open bite malocclusion. If the difference is smaller, the ODI value will also be lesser but the posterior facial height will be larger in measurement.

CONCLUSION:

1. The maxillary and mandibular base length and the average of lower face heights are almost equivalent in normal subjects.
2. In openbite patients, the maxillary and mandibular base lengths are smaller, facial heights, vertical sagittal ratio and the sagittal angle is greater, the maxillary and mandibular posterior extension is shorter.
3. Openbite females showed a lesser < FC indicating a convex profile than the male subjects.
4. ODI in females was greater than males.

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Correction Notes

Below mentioned article was used as a reference in the article titled as "Rehan Q. Incidence of anterior open bite among patients reporting to Lahore Medical & Dental college, Lahore. Pak Orthod Jr 2009;1(1):15-17. but authors name were not listed. Regrets from Dr Hameed Ullah Jan & Co Authors for this mistake. *Hameedullah JM, Bushra A, Amair K. Frequency of anterior open bite patients reporting to AFID, Rawalpindi. Pakistan Oral & Dental Journal 2008:28:71-3*