ORIGINAL ARTICLE

THE SKELETAL MORPHOLOGIC STRUCTURE OF OPENBITE IN ADULT PAKISTANI SAMPLE

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ABSTRACT

The purpose of this study was to identify the cephalometric skeletal morphological features of anterior open-bite (AOB) in adult Pakistanis. It was a cross sectional descriptive study having quantitative study design. Lateral cephalograms of 30 pre treatment anterior open-bite patients with the age range 17 to 27 years, coming to the department of Orthodontics were taken (18 females and 12 males). Subjects of study sample were clinically diagnosed as having open bite.In addition the subjects were considered as having skeletal AOB when SN-GoGn angle was equal to or more than 32.5 degree. Ten linear and angular measurements were recorded.

The results showed significantly increased values of linear measurements (PHF, AFH, UFH) and angular measurement(SN-GoGn).One angular measurement(SN-PP) was closer to the mean Caucasian sample values but there was more obliquity to the Gonial angle. The ratio PFH/AFH was small as compared to white anterior AOB subjects. Sexually dimorphic variables were also identified by independent sample t-test.

Key Words: *Anterior open bite (AOB). Skeletal Dysplasia. Skeletal Morphology. Hyperdivergent skeletal pattern.*

INTRODUCTION

The Anterior Open Bite (AOB) is characterized by the absence of contact of incisal edges of maxillary and mandibular teeth in the vertical plane.[1] Etiology of Open bite is complex and multifactorial.[2]

The facial morphology of individuals with skeletal anterior open bite is characterized by striking vertical disproportions caused by abnormal ratios between anterior and posterior facial heights (AFH/PFH) and between upper and lower anterior facial heights (UFH/LFH). A short ramus, steep mandibular plane and increased lower facial height and an increased gonial angle also contribute to the hyperdivergent skeletal, pattern.[3,4,5,6,7]

Studies related to AOB have implicated many potential etiologic factors, including unfavorable growth patterns[8], digit-sucking habits[9,10], lymphatic tissue[11,12], tongue and orofacial muscle activity[13], orofacial functional matrices[14], mental retardation11, and imbalances between jaw posture, occlusal and eruptive forces, and head position.[15]

With appropriate differential diagnosis, aberrations in maxilla and/or mandible and severity of the problem can be recognized and the treatment option is decided. Identifying the skeletal pattern of an open-bite may also be helpful in the possible prevention or treatment planning for mature patient.[16] Cephalometric standards are available for different AOB samples of blacks, whites and Chinese races only.[16,17,18,19,20] There is no data, available on skeletal characteristics of AOB individuals in Pakistani population.

The purpose of the study was to evaluate the morphologic characteristics of skeletal open bite in Pakistani adults and to establish population norms of craniofacial patterns for AOB sample. Values obtained were also compared with the standard for white anterior open bite individuals.

METHODOLOGY

This was a cross sectional descriptive study having qualitative study design. Orthodontic records including lateral cephalograms with anterior open-bite (AOB) were collected.

All the subjects of study sample were clinically diagnosed with open bite at least 1 millimeters as a distance between incisal edges of maxillary and mandi-

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bule incisors when they were projected perpendicular to facial plane (N-Me).[21] The subjects were considered as having skeletal AOB when SN-GoGn angle was equal to or more than 32.5 degree.[22]

The cephalometric radiographs of the study sample were traced on .003 inches thick and 8 by 10 inch acetate paper with 4h lead pencil. Cephalometric landmarks used were identified and reference planes were drawn on tracing of lateral cephalogram. Linear and angular measurements were recorded for individual patients.

Thirteen Parameters were used for statistical evaluation. The data was analyzed in SPSS 10.0 for windows. The descriptive statistics for cephalometric measurements included arithmetic means, mode, minimum, maximum, standard deviation and range for all the quantitative measurements.

These measurements were compared with the standard already set for white AOB samples.[16] Student's t test was used for comparing results with the standards for white subjects and for comparing females with males. Retracing 15 cephalograms and applying the paired sample t- test recorded the Method error.

Males and female values were also compared by using the independent Student's t-test.

Cephalometric measurements

Following lateral landmarks points/lateral planes were identified on the lateral radiographs.

Sella: The midpoint of the pituitary fossa of the sphenoid bone.

Nasion: The intersection of the internasal suture with the nasofrontal suture in the midsagittal plane.

Gonion: The point on the jaw angle, which is the most inferiorly, posteriorly and outwardly directed.

Gnathion: The most inferior point in the contour of the chin.

Menton: The lower most point on the shadow of symphsis.

Anterior nasal spine: The tip of the anterior nasal spine.

Posterior nasal spine: The tip of posterior nasal spine of palatal bone.

Articulare: Intersection of posterior border of mandible (Mandibular plane) with basi occiput.

SN-Na. Sella to nasion(Sella Nasion plane)

ANS to PNS (Maxillary plane)

GOGn Gonion to Gnathion (Mandibular plane)

Ramal plane Pogonion to Articulare

Following skeletal linear measurements/Angular measurements were taken.

Posterior face height: Sella to gonion.

Anterior face height: Nasion to menton.

Upper face height: Nasion to palatal plane.

Lower face height: Palatal plane to menton.

SN-GoGn: Angle formed by the sella nasion line and mandibular plane.

Gonial Angle: Angle formed by the posterior border of ramus of mandible (Ramal plane) and the mandibular plane.

SN-PP: Angle formed by the sella nasion line and palatal plane.

PP-GoGn: The angle formed by the palatal plane and the mandibular plane.

RESULTS

The mean amount of open-bite in the sample was 2.63 mm with the range of 1 to 6mm.

SKELETAL ANGULAR AND LINEAR CHARACTERISTICS

When study sample was compared to white anterior open-bite subjects for angular and linear measurements, it was observed that the subjects in the study sample had significantly greater linear and angular measurements compared to white subjects. The results showed significantly high values of mandibular plane angle (SN-GoGn). Maxillomandibular (PP-GoGn) angles. The craniomaxillary angle (SN-PP) and gonial angle were closer to the mean Caucasian sample values.

The ratio of posterior to anterior facial height (PFH/AFH) was small indicating greater value of total anterior facial height of the study sample. The lower facial height (LFH) was also found to be greater in relation to upper facial height in the study sample which confirms the skeletal component of the study sample.

Mean value of SN-GoGn was 43.48 of SN-PP was 8.9 PP-GoGn was 35.60 and gonial angle was 132.0. PFH was 76.50 and AFH was 140.0

The mean, range and mode of the skeletal and linear cephalometric characteristics of the study sample are shown in Table 1. The difference between two samples was significant. Comparisons are shown in Table 2.

GENDER DIMORPHISM

Sexually dimorphic variables were identified by independent sample t-test. It was found that the males in general had greater mean linear and skeletal cephalometric values as compared to females in the study sample. The results are shown in Table 3. and Table 4. Cephalometric results reported are of general agreement with previous reports. The data obtained in this study indicated that severity of anterior open-bite

TABLE 1: SKELETAL (IN DEGREES) N = 15 / LINEAR CHARACTERISTICS (MM) AND RATIO'S N = 30

Cephalometric Parameter	Minimum	Maximum	Mean±SD	Mode	Median
PFH	70.00	94.50	81.00±5.70	76.50	81.00
AFH	117.0	140.0	129.0±7.04	140	128.25
UFH	50.00	65.00	56.23±4.12	53.50	55.25
LFH	55.00	80.00	72.83±5.5	66.50	73.50
PFH/AFH ratio	54.68	68.97	62.83±3.7	63.50	63.54
UFH/LFH ratio	65.51	88.40	76.66±5.6	80.45	77.01
Gonial Angle	121.00	144.00	132.4±6.07	132.0	132.0
SN-PP	5.00	14.00	8.9±2.30	8.0	9.0
PP-GoGn	26.00	30.00	35.60±6.37	32.0	34.0

TABLE 2: COMPARISON OF CAUCASIAN AND PAKISTANI SAMPLE

	Pakistani			White			
Cephalo-metric Parameter	Mean AOB	S.D	Range	Mean AOB	S.D	Range	
PFH	81.00	5.70	24.5	73.8	8.2	32.5	7.2
AFH	129.00	7.04	23.0	122.8	12.4	46	6.2
UFH	56.23	4.12	15.5	51.9	4.7	15.5	10.8
LFH	72.53	5.54	25.5	70.8	9.0	22	1.73
PFH/ FH	62.83	3.7	14.29	60.2	4.4	20.4	2.63
UFH/LFH	76.66	5.6	28.89	74.0	7.1	31.7	2.66
SN-GoGn	43.48	5.64	22.00	38.3	6.4	26-54.5	5.18
Gonial angle	132.46	6.07	23.00	132.5	6.0	120-145	-.04
SN-PP	8.90	2.30	09.00	7.1	3.7	1.5-19	1.4
PP-GoGn	35.60	6.37	84.00	31.4	5.8	19-44.5	4.2

TABLE 3: COMPARISON OF FEMALE AND MALES FOR SKELETAL MEASUREMENTS (DEGREES)

		SN-GoGn	SN-PP	PP-GoGn	Gonial angle
	F	54.00	144.00	14.00	45.00
Maximum	M	55.00	141.00	12.00	50.00
	F	33.00	121.00	5.00	23.00
	F				
Minimum	M	35.00	124.00	5.00	27.00
	F	42.58	130.83	8.88	34.11
Mean	M	44.83	134.91	8.91	37.83
	F	5.35	6.42	2.27	5.21
S.D	M	6.02	4.73	2.46	7.48
	F	43.00	132.00	8.00	32.00
Mode	M	43.00	134.00	0.00	32.00
	F	21	23	9	9
Range	M	20	17	7	23
t-value		-1.072	-1.88	-.032	-1.61
p-value		.293	.070	.975	.119

TABLE 4: COMPARISON OF FEMALE AND MALES FOR LINEAR MEASUREMENTS (MM)

		PFH	AFH	UFH	LFH	PFH/AFH	UFH/LFH
	F	84.50	140	65.50	77.00	68.93	88.40
Maximum	M	94.50	140	62.00	80.50	68.97	81.33
	F	70.00	117	50.00	55.00	68.72	67.11
Minimum	M	73.00	120	51.00	66.50	54.68	65.51
	F	79.41	125.88	55.75	70.19	63.21	78.19
Mean	M	83.37	133.87	56.95	76.79	62.25	74.37
	F	3.90	6.05	4.44	2.02	3.35	5.40
S.D	M	7.20	5.70	3.67	3.66	4.27	5.3
	F	76.50	119.0	53.50	72.50	56.93	80.45
Mode	M	73.00	133.50	58.00	76.50	54.68	65.51
	F	23.00	14.50	15.50	22.00	11.79	21.29
Range	M	21.50	20.00	11.00	14.00	14.29	15.82
t-value		-1.95	-3.619	-.780	-3.89	-.692	-1.913
p-value		.061	.001	.442	.001	.494	0.066

is greater in the study sample.The great variation in skeletal morphology of study sample is apparent.

DISCUSSION

Anterior open bite is a complex clinical entity that entails a combination of different 3-dimential dental and skeletal components.[23] The etiology; diagnosis and treatment planning have traditionally been based on skeletal cephalometric characteristics.

Comparing the values of PFH, AFH, UFH, UFH, and LFH with the Caucasian Sample we found higher values of all the skeletal linear measurements. Ratios of posterior facial height to anterior facial height and upper facial height to lower facial height also confirmed that lower facial height and total facial height is more in our sample than the Caucasian sample. Although we did not divide sample into skeletal and dental open bites, the skeletal vertical dimension was the major factor in the increased tendency toward open bite.

The average ratio of PFH to AFH was statistically different and reflects increase in anterior facial height. Previous studies[7.16,22] have reported that open-bite patients also tend to have shorter posterior face height but this was not found in the present study.

Shudy[8] stated that the vertical dimension is the most important to clinical orthodontist. He stated that retrognathic persons are likely to exhibit greater lower facial heights where as prognathic persons are more likely to exhibit greater lower facial face heights.

Cangialosi[16] and Nahoum[21] concluded from their studies that the Posterior face height is shorter, overall anterior face height and lower face height is greater in relation to upper anterior face height in AOB subjects. The mandibular plane angle, Gonial and PP-GoGn angle are larger in persons with AOB. Our results were in accordance with their results. Cangialosi16 found that the ratio of upper facial height to total facial height was smaller for subjects with anterior open bite, and that this ratio remained relatively constant with age. A few studies[7,22] reported differences between the two, while others[16] showed a significant decrease in posterior facial height in AOB cases. The differences in values were probably due to different age of sample in these studies.

Tsang[20] studied cephalometric characteristics of skeletal open-bite in 104 subjects and compared them with 40 controls for sexual dimorphism. He found that sexual dimorphism of cephalometric variables is present in the test and contro group, but affected more variables in the test group, which is same as in this sample. Subtelny and Sakuda[7] found that palatal plane angle was normal in anterior open bite cases; other authors[21,22] reported a decrease in the palatal plane angle.

Richardson[14] found that there was a significantly greater lower face height and greater jaw and joint angles in open bite cases. He concluded that the cause of open bite from 7 to 10 years of age is delayed vertical growth of upper face and increase lower face height, combined with lack of growth of dentoalveolar structures. He believed that, with time,the growth of upper face will correct itself but that vertical development of the dentoalveolar structures will never catch up. There it seems that anterior open bite may be attributed to both skeletal and dentoalveolar discrepancies.

Without a population norm, the use of cephalometric analysis to diagnose and treat patients with

dentofacial deformities in the population is limited, as cephalometric norms are used to determine the normality, abnormality, location and extent of dentofacial deformity for that particular racial group. There have been many studies of different racial group showing that skeletal and dental patterns can, and do,vary. Examples can be cited where specific physical characteristics or attributes that are commonly found in a racial group come to be described as typical for that race or ethnic group.[14]

A thorough knowledge can have great therapeutic implications. These measurements can be very important from the standpoint of early interception. It enables the orthodontist to avoid the use of those mechanics, which may tend to rotate the mandible downward and backward, increasing anterior face height and decreasing the ratio of posterior to anterior face height. It also helps in determining those cases that will require a combination of orthodontics and surgery to obtain satisfactory functional and esthetic results.[16]

CONCLUSIONS

This study confirms previous studies that showed the open bite malocclusion is largely due to changes in the skeletal pattern. Following conclusions were drawn from the study of Pakistani open-bite sample. The anterior open-bite in the study had skeletal origin. There were divergent skeletal cephalometric planes. The values of PP-GoGn were slightly greater than that of white sample. The mandibular plane angle showed increased values than the white AOB sample. The value of the Gonial angle was statistically similar in both groups. Poterior facial heights were shorter and anterior face height was greater in open-bite subjects of study sample, as in white sample but values were greater in study sample. Lower facial height was greater in relation to upper facial height in the sample. Comparing male and female group all the linear and angular cephalometric measurements exhibited significantly greater values for males as compared to female subjects.

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