Original Article

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EVALUATION OF CONDYLAR ASYMMETRY IN DIFFERENT SKELETAL PATTERNS IN POST-ADOLESCENTS

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ABSTRACT

Introduction: The vertical condylar asymmetry has been investigated in adolescents with no clinical signs or symptoms of temporomandibular joint disorders. Since, there is residual growth of the mandible during adolescence; this study would be more affirmative, if it is done in post-adolescence period. **Aims and Objectives:** The purpose of this study was to investigate vertical condylar asymmetry in post-adolescents with no clinical signs or symptoms of temporomandibular joint disorders using panoramic radiographs. **Materials and Methods:** The vertical asymmetry measurements were investigated on the panoramic radiographs of 78 subjects having different skeletal patterns. Condylar height, ramus height and total ramus height on both the sides were measured for each subject and asymmetry indexes were calculated. The effect of the sex and ANB angle on the vertical asymmetry measurements was determined by means of variance analysis. **Results:** The mean condylar asymmetry index of group 1, group 2 and group 3 was 6.112%, 5.043% and 3.855% respectively and the mean ramus asymmetry index of group 2 was 3.110% which was greater than the 3% cut-off reported in the literature. Variance analysis showed that vertical condylar, ramus and condylar plus ramus asymmetry measurements were not affected by the sex and ANB angle. **Conclusion:** This study suggested that vertical condylar asymmetries (greater than 3% cutoff) exists among post-adolescents with no clinical signs and symptoms of temporomandibular joint disorders and vertical condylar, ramus and condylar plus ramus asymmetry indexes were not affected by the sex and ANB angle in these patients.

KEYWORDS: Condylar asymmetry; Mandibular asymmetry; Asymmetry indexes

INTRODUCTION

'Facial asymmetry' refers to disproportion between two normally alike facial landmarks on the opposite sides of median sagittal plane. Mulick[1] cited that asymmetry in the craniofacial region was first documented by an artiste Hasse whose investigations of early Greek statuary revealed slight to moderate asymmetries in the creation of artistic works. Although many faces may appear symmetrical and well balanced on clinical soft tissue evaluation, radiographic studies by Fischer,[2] Letzer and Kronman[3] and Shah and Joshi[4] revealed varying degrees of craniofacial asymmetry as a characteristic of all faces. It serves to characterize and to individualize the aesthetically pleasing face rather than to disfigure it. Liu[5] reported that only facial asymmetries greater than 3% are clinically discernible. Asymmetry in the lower third of the face referred as 'mandibular asymmetry' cause aesthetic and functional problems. 'Condylar asymmetry' is the disproportion of vertical condylar height between right and left mandibular condyles. Condylar asymmetries are thought to be one of the most important causes of mandibulofacial asymmetries.[6-8] Saglam AM (2003)[9] investigated condylar asymmetry in different skeletal patterns using ANB angle as the skeletal sagittal discrepancy indicator in adolescents with no clinical signs or symptoms of temporomandibular joint disorders. Liukkonen M *et al.*,[10] assessed mandibular asymmetry in healthy children and demonstrated its fluctuation during growth. The present study was undertaken to overcome these fluctuations occurring during growth. The aims and objectives of this study was to assess vertical condylar, ramus and condylar plus ramus asymmetry in post-adolescents with no clinical signs or symptoms of temporomandibular joint disorders using panoramic radiographs and to determine the

Table I: The Mean, Standard Deviation and Range of the Right and Left Condylar Heights (in Millimeters) of the Study Groups

PARAMETERS	GROUP		N	MEAN	SD	MIN	MAX
LEFT CONDYLAR HEIGHT	ANB = 2	M	13	27.35	3.805	19	35
		F	13	26.62	4.810	20	38
	ANB > 2	M	13	26.69	3.767	21	34
		F	13	23.96	3.479	20	31
	ANB < 2	M	13	28.88	4.524	23	38
		F	13	26.42	3.813	21	33
RIGHT CONDYLAR HEIGHT	ANB = 2	M	13	25.54	3.294	20	31
		F	13	24.04	4.260	20	36
	ANB > 2	M	13	25.96	3.461	20	32
		F	13	23.50	3.342	20	32
	ANB < 2	M	13	26.65	5.222	21	39
		F	13	26.23	3.914	22	33

Table II: The Mean, Standard Deviation and Range of the Right and Left Ramus Heights (in Millimeters) of the Study Groups

PARAMETERS	GROUP		N	MEAN	SD	MIN	MAX
LEFT RAMUS HEIGHT	ANB = 2	M	13	53.19	7.677	39	64
		F	13	44.69	3.998	39	50
	ANB > 2	M	13	50.23	5.630	44	60
		F	13	43.92	6.194	35	58
	ANB < 2	M	13	53.38	5.013	45	62
		F	13	45.65	4.806	38	54
RIGHT RAMUS HEIGHT	ANB = 2	M	13	52.46	8.280	38	67
		F	13	44.31	2.488	39	49
	ANB > 2	M	13	48.92	6.314	39	62
		F	13	42.31	5.622	33	51
	ANB < 2	M	13	53.38	5.676	46	64
		F	13	43.23	4.280	37	49

Table III: The Mean, Standard Deviation and Range of the Total Ramus Heights (in Millimetres) of the Study Groups

PARAMETERS	GROUP		N	MEAN	SD	MIN	MAX
LEFT TOTAL RAMUS HEIGHT	ANB = 2	M	13	80.54	8.523	69	95
		F	13	71.31	4.176	63	77
	ANB > 2	M	13	76.92	6.034	67	88
		F	13	67.88	5.643	59	79
	ANB < 2	M	13	82.27	4.885	73	89
		F	13	72.08	5.307	65	81
RIGHT TOTAL RAMUS HEIGHT	ANB = 2	M	13	78.00	8.607	62	90
		F	13	68.35	3.502	63	77
	ANB > 2	M	13	74.88	5.512	67	85
		F	13	65.81	4.576	58	75
	ANB < 2	M	13	80.04	5.154	72	89
		F	13	69.46	5.502	59	77

effect of sex and ANB angle on the condylar, ramus and condylar plus ramus asymmetry measurements.

MATERIALS AND METHODS

Case records, models, cephalograms and panoramic radiographs of 78 patients (39 males and 39 females) aged 19-30yrs attending Department of Orthodontics and Dentofacial Orthopedics of M. S. Ramaiah Dental College and Hospital, Bangalore for seeking orthodontic treatment were used for this study. The cephalograms and panoramic radiographs were taken using PM 2002 CC PROLINE CEPH CM (Planmeca Co., Helsinki, Finland) under standardized conditions.

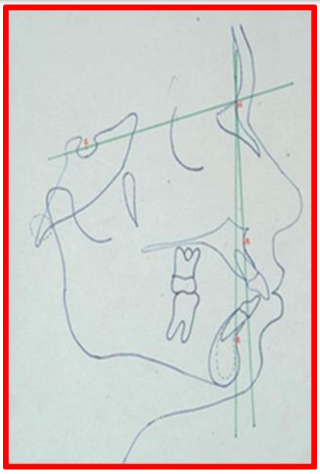

Fig. 1: Tracing of a Lateral Cephalogram of a Subject Showing Various Anatomical Landmarks and Measurements Used in this Study

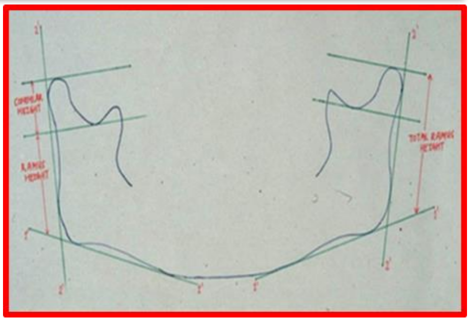

Fig. 2: Tracing Of Panoramic Radiograph of a Subject Showing Various Anatomical Landmarks and Measurements Used in this Study

Table IV: The Mean, Standard Deviation and Range of Condylar, Ramus and Condylar Plus Ramus Asymmetry Indexes (in Percentage) of the Study Groups

PARAMETERS	GROUP	N	MEAN	SD	MIN	MAX
CONDYLAR ASYMMETRY INDEX	ANB = 2	26	6.112	4.6177	0.00	16.33
	ANB > 2	26	5.043	3.7636	0.00	12.15
	ANB < 2	26	3.855	3.0693	0.00	10.89
RAMUS ASYMMETRY INDEX	ANB = 2	26	1.994	1.3979	0.49	6.10
	ANB > 2	26	3.110	2.5688	0.00	8.77
	ANB < 2	26	2.565	2.2091	0.00	11.38
CONDYLAR PLUS RAMUS ASYMMETRY INDEX	ANB = 2	26	2.005	1.7389	0.31	6.05
	ANB > 2	26	1.828	1.3150	0.35	5.69
	ANB < 2	26	1.887	1.6576	0.00	7.09

Table V: The F-Values Found by Variance Analysis

FACTORS	PARAMETERS	DEGREE OF FREEDOM	'F' VALUE	'P' VALUE
ANB	CONDYLAR ASYMMETRY INDEX	2	2.192	0.119
	RAMUS ASYMMETRY INDEX	2	1.828	0.168
	CONDYLAR PLUS RAMUS ASYMMETRY INDEX	2	0.082	0.921
SEX	CONDYLAR ASYMMETRY INDEX	1	1.751	0.190
	RAMUS ASYMMETRY INDEX	1	0.119	0.731
	CONDYLAR PLUS RAMUS ASYMMETRY INDEX	1	0.736	0.394
ANB X SEX	CONDYLAR ASYMMETRY INDEX	2	0.249	0.780
	RAMUS ASYMMETRY INDEX	2	1.867	0.162
	CONDYLAR PLUS RAMUS ASYMMETRY INDEX	2	0.031	0.969

Patients with proper case records, models, panoramic radiographs and lateral cephalograms, no missing teeth except third molars and no previous history of occlusal adjustment or orthodontic treatment were included in this study. Patients with posterior crossbites (unilateral or bilateral), mandibular deviation during closure and any history of jaw trauma, symptoms of occlusal trauma, masticatory disharmony, pain during jaw movements or clinically diagnosed temporomandibular joint disorders were excluded from this study. The study group consisted of 78 subjects with various skeletal patterns and was divided into 3 groups with 26 subjects each according to skeletal pattern based on Steiner's norms (Fig. 1). They were grouped as follows:

Group 1: ANB = 2°, Group 2: ANB > 2° and Group 3: ANB < 2°. In addition, each group was divided into subgroups according to sex (13 subjects each). Condylar asymmetry was measured according to the method used by Kambylafkas P *et al*.[11] Panoramic radiographic films were traced on matte acetate paper with 3H pencil. Condylar height, ramus height and total ramus height on both the side were measured for each subject (Fig. 2). Condylar, ramus and condylar plus ramus asymmetry indexes were estimated using the following formulae: asymmetry index (AI) = | (R-L)/(R+L) | *100

The measurements were performed by one investigator on the panoramic radiographs of the subjects using a digital vernier calliper (Aerospace Co., India) with 0.01 mm sensitivity.

RESULTS

Data was fed in microsoft excel and analyzed using SPSS (Statistical Package for Social Science, Ver.10.0.5) package. The student 't' test was performed to determine whether a statistical difference exists between male and female in the parameters measured. Analysis of variance was used to test the difference between study groups and compare the effect of ANB angle and sex on asymmetry measurements. The paired 't' test was performed to determine the error of method associated with radiographic tracings and measurements. In all the above test, 'p' value of less than 0.05 was accepted as statistically significant. The mean age of group 1, group 2 and group 3 was 22.08 ± 2.348 years, 21.77 ± 2.026 years and 21.58 ± 2.671 years respectively. Student 't' test showed that there was statistically significant difference (p=0.017) among males and females in group 2 regarding age. The mean ANB angle of group 1, group 2 and group 3 was 2 ± 0.49°, 4.83 ± 1.414° and -0.94 ± 2.109° respectively. Student 't' test showed that there was no statistically significant difference (p>0.05) between male and female groups regarding ANB angle. The mean, standard deviation and range of the right and left condyle, ramus and total ramus heights (in millimeters) of the study groups are presented in table I, II and III. The mean, standard deviation and range of condylar, ramus and condylar plus ramus asymmetry indexes (in percentage) of the study groups are presented in table IV. The effect of sex and ANB angle on the asymmetry measurements was investigated by variance analysis. The results of the variance analysis are presented in table V. No statistically significant difference was found between the groups (p>0.05). The vertical condylar, ramus and condylar plus ramus asymmetry index measurements were not affected by the sex and ANB angle. Fifteen panoramic radiographs were selected randomly from the study group and tracings and measurements were repeated after one week to determine intra-examiner error. No statistically significant difference was found between these two readings.

DISCUSSION

Bezuur *et al.*,[12,13] investigated the possible role of condylar asymmetry on the pathogenesis of craniomandibular disorders and suggested that the use of a screening protocol and a panoramic radiograph could be of preventive importance in daily practice. The use of panoramic radiographs in evaluating mandibular asymmetries concerns the effect of magnification occurring at the vertical dimensions of the mandible on the vertical measurements. In a recent study, Kambylafkas *et al.*,[11] showed that panoramic radiographs could be used to assess vertical posterior mandibular asymmetries. The reproducibility of vertical measurements on panoramic radiographs is acceptable if the patients head position is standardised. In the present study, all the films were taken in standardised conditions and poor quality radiographs were excluded. Habets *et al.*,[14,15] and Saglam AM and Sangli G[16] investigated the relationship between temporomandibular joint disorders and condylar asymmetry and found increased condylar asymmetry indexes in subjects with temporomandibular joint disorders. In the present study, patients with clinical signs and symptoms of temporomandibular joint disorders were excluded. Habets *et al.*,[14,15] found that asymmetry index values greater than 3% must be taken into consideration as vertical asymmetries. The asymmetry values smaller than 3% may arise because of technical errors during film exposure. In the present study, the mean condylar asymmetry index of group 1, group 2 and group 3 was 6.112%, 5.043% and 3.855% respectively. The mean condylar index in all the three groups was greater than 3% cut-off reported in the literature. The mean ramus asymmetry index of group 2 was 3.110% which was slightly greater than the reported 3% cut-off in the literature. Other studies evaluating condylar asymmetry in different malocclusions also found asymmetry values greater than 3% both in study and control groups.[9,16-20] Miller VJ *et al.*,[17] investigated the relationship between condylar asymmetry and age in subjects with Angle's Class II division 2 malocclusion with deep overbite and no signs or symptoms of temporomandibular joint disorders and Angle's Class I occlusion as controls and found no statistically significant differences between these groups. The mean condylar asymmetry index of Angle's Class II division 2 malocclusion group and Angle's Class I occlusion group was 3.94% and 4.42% respectively. In the present study, the mean condylar asymmetry index of group 2 was 5.043% which was similar to this study. Kurt G *et al.*,[18] evaluated the mandibular asymmetry in a group of patients with Angle's Class II subdivision malocclusion with no signs and symptoms of temporomandibular joint disorders and normal occlusion as controls and found no statistically significant differences. The mean condylar asymmetry index of Angle's Class II subdivision group and normal occlusion group was 11.56% and 7.57% respectively whereas in the present study, the mean condylar asymmetry index in group 2 where ANB > 2° was 5.043%. The difference in the values may be due to Angle's Class II subdivision type of malocclusion. Miller VJ and Bodner L[19] investigated the relationship between the condylar asymmetry and age in subjects with Angle's Class III malocclusion and no signs and symptoms of temporomandibular joint disorders and Angle's Class I occlusion as controls and found no statistically significant differences between these groups. The mean condylar asymmetry index of Angle's Class III malocclusion group and Angle's Class I occlusion group was 4.14% and 4.42% respectively. In the present study, the mean condylar asymmetry index in group 3 was 3.855% which was similar to this study. Sezgin OS *et al.*,[20] investigated the effects of different occlusion types on the mandibular asymmetry in young individuals with no signs and symptoms of temporomandibular joint disorders and found that Angle's Class II division 1 malocclusion had a significant effect on the condylar asymmetry index when compared to Angle's Class II division 2 malocclusion, Angle's Class III malclusion and normal occlusion types. In our study, condylar asymmetry index had no influence on the change of ANB angle. The most commonly used indicator for determining anteroposterior skeletal discrepancy is ANB angle. Saglam AM[9] investigated the effect of ANB angle on condylar asymmetry in subjects with no clinical signs or symptoms of temporomandibular joint disorders in adolescents and found that the condylar plus ramus index measurement was affected by the change of ANB angle. In our study, condylar plus ramus index measurement was not affected by the change of ANB angle. Studies of the etiology of condylar asymmetries by Saglam AM,[9] Sezgin OS *et al.*,[20] and Kurt G *et al.*,[18] in which gender differences have been investigated revealed no statistically significant differences regarding asymmetry measurements. In the present study, no gender related statistically significant differences were found between the study groups regarding asymmetry measurements.

CONCLUSION

This study suggested that vertical condylar asymmetries (greater than 3% cutoff) exists among post-adolescents with no clinical signs and symptoms of temporomandibular joint disorders and condylar, ramus and condylar plus ramus asymmetry indexes were not affected by the sex and ANB angle in these patients. Future studies should use 3D imaging technologies to overcome technical errors and should assess the clinical significance of these increased asymmetry indexes.

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