

CLASS- III - MALOCCLUSION: A CEPHALOMETRIC STUDY IN A PAKISTANI POPULATION SAMPLE

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ABSTRACT

This study was carried out to evaluate the Cephalometric characteristics of class-III malocclusion in a sample of Pakistani population with age range 18-25 years visiting Orthodontics department, de'Montmorency college of Dentistry / Punjab dental hospital, Lahore. Lateral Cephalometric radiographs, Orthopantomograms, Study casts, extra oral and intra oral photographs were taken for every patient. Results indicate that regarding the Cephalometric characteristics of Pakistani patients with class III malocclusion, the Maxilla showed retrognathism in relation to cranial base both for angular and linear parameters in antero-posterior relationship while the Mandible showed prognathism in relation to cranial base both for angular and linear parameters in antero-posterior relationship. However the Dento-alveolar measurements showed maxillary incisors proclination and mandibular incisors retroclination, suggestive of dental compensation to skeletal discrepancy. Males showed comparatively horizontal while females exhibited vertical growth tendency.

Key words: Class III malocclusion, cephalometric characteristics, Pakistani sample.

INTRODUCTION

Skeletal Class III malocclusion is usually characterized by a steep mandibular plane angle, obtuse gonial angle, overdeveloped mandible, underdeveloped maxilla, and a small cranial base angle, which may displace the glenoid fossa anteriorly to cause a forward positioning of the mandible¹. This type of facial dysplasia is produced by excessive growth disharmony of the mandible in size, form, and position with respect to maxilla and / or the cranial base^{2, 3}

The prevalence of class III malocclusions varies among the races. The percentage of this type of malocclusion in white population is less than 5 %. On the other hand, the prevalence of skeletal class III malocclusion has been reported to be 0.5 % to 1.6 % in Caucasians^{4,5}, 14.5 % in Chinese⁶, 4.0 % to 13.0% in Japanese⁷, 9.4 % to 19 % in Koreans⁸ and 2.9% in Indian children with age range of 9-14 years⁹.

Class III malocclusions are considered one of the most complex and difficult orthodontic problems to diagnose and treat^{10, 11, 12}. It is now well established that this malocclusion is not limited to dental discrepancies but is often related to an underlying skeletal problem¹³. Studies conducted to identify the etiologic features of a Class III malocclusion showed that the deformity is not restricted to the jaws but involve the total craniofacial complex^{14, 15, 16}.

The previous investigators have described the morphologic characteristics of Pakistani population with respect to class I¹⁷ and class III^{6,18} relationships. Although the reported prevalence of class III malocclusion is different among races, no such study has been previously conducted in Pakistan to examine the morphologic characteristics of this type of malocclusion.

The objective of this study was to evaluate the Cephalometric characteristics of class III malocclusion

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in a sample of Pakistani population visiting Orthodontic department, de' Montmorency college of Dentistry / Punjab dental hospital, Lahore. This study will serve as a useful tool in the diagnosis and treatment planning of class **III** malocclusion.

MATERIALS AND METHODS

Fifty patients (25 males and 25 females) with age range 18-25 years, having Angle's class **III** molar relationship with no previous orthodontic treatment were selected from orthodontics department of de, Montmorency College of Dentistry/ Punjab Dental Hospital, Lahore. Complete set of diagnostic records including: Lateral Cephalometric radiographs, Orthopantomogram, Study casts, Extra oral and intra oral photographs were taken for every patient. However patients with craniofacial skeletal deformities (cleft lip and palate, facial asymmetry, syndromes), any previous trauma to dento facial structures, TMJ ankylosis or dislocation and missing or cariously damaged dentition were excluded from the study.

Lateral Cephalometric radiographs for all the patients were taken with the teeth in centric occlusion and relaxed lips. All the radiographs were taken in the Department of Radiology, de' Montmorency College of Dentistry/ Punjab Dental Hospital, Lahore.

All Lateral Cephalometric radiographs were traced on 0.003 inches thick and 8x10 inches acetate sheet with 4H lead pencil. All the radiographs were traced at the same sitting to minimize tracing error. Cephalometric landmarks and planes were determined manually (Fig 1). The cranio facial relationships were divided in to following categories for analysis: Cranial base, Maxillary, Mandibular, Dento-Alveolar and Soft tissue relationships (Table 1). The linear and angular measurements were adopted from Downs, Steiner's, McNamara and Rickett's cephalometric analysis (Figs 2 and 3).

The data was compared with Downs²⁶, Steiner's¹⁹, McNamara²⁰, Rickett's²⁵ and Tajik,^{s17} normal values for class **I** skeletal relationships. Male and female samples were also compared to evaluate any sexual dimorphism.

Statistical analysis

The database of all the measurements was developed in SPSS info version 8.0 software. The arithmetic

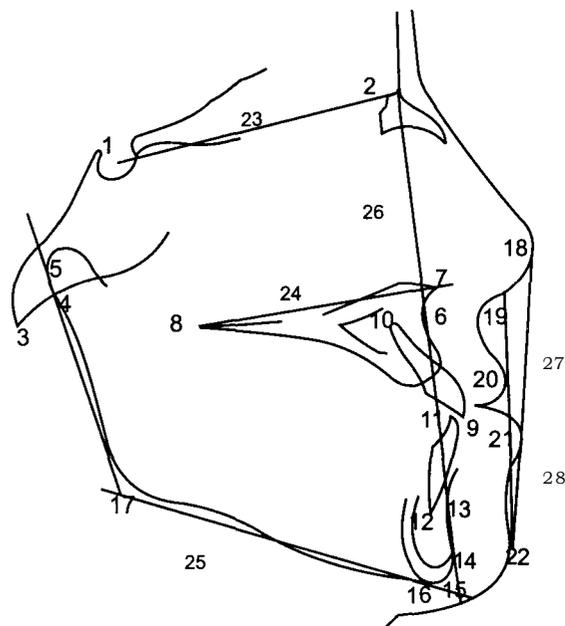


Fig. 1. Cephalometric Landmarks and Planes

1. S-Sella, 2. N-Nasion, 3. Ba-Basion, 4. Ar-Articulare, 5. Co-Condylion, 6. Pt.A, 7. ANS-Anterior nasal spine, 8. PNS-Posterior nasal spine, 9. Upper incisor tip, 10. Upper incisor apex, 11. Lower incisor tip, 12. Lower incisor apex, 13. Pt.B, 14. Pog-Pogonion, 15. Gn-Gnathion, 16. Me-Menton, 17. Go-Gonion, 18. Pronasale, 19. Subnasale, 20. Upper lip, 21. Lower lip, 22. Soft tissue Pogonion, 23. S-N Plane, 24. Palatal/Maxillary Plane, 25. Mandibular Plane, 26. Facial plane, 27. Rickett's E-Plane, 28. S-Line

means, standard deviation, standard error of means and range for all the quantitative variables were analyzed (Table.2). A paired t-test was applied to calculate statistical significance level of any difference between males and females (Table.3).

To evaluate the method error, 15 radiographs were randomly selected and manually retraced for all the variables. The retraced values were compared with first readings of the same radiographs, using paired t-test. There was statistically insignificant difference between first and second tracing on applying paired t-test.

The levels of significance used were a probability value of less than **0.001** (highly significant), a value less than 0.01 (significant) and a value less than 0.05 (insignificant).

TABLE 1: CEPHALOMETRIC MEASUREMENTS USED IN PRESENT STUDY

Cranial base	Maxillary	Mandibular	Inter-maxillary	Facial Heights	Dento-alveolar	Soft tissue
S-N (mm)	SNA (°)	SNB (°)	ANB (°)	PFH (mm)	SN-UI (°)	UL-E.line (mm)
N-S-Ba (°)	SN-PP (°)	SNPg (°)	MMA (°)	AFH (mm)	PP-UI (°)	UL-S.Line (mm)
	Co-Pt.A (mm)	SN-MP (°)		LAFH (mm)	IMPA (°)	LL-Sline (mm)
		Y-axis (°)			IIA(e)	LL-S.line (mm)
		S-Ar-Go (°)				NLA (°)
		Ar-Go-Gn (°)				
		Co-Gn (mm)				
		Go-Gn (mm)				

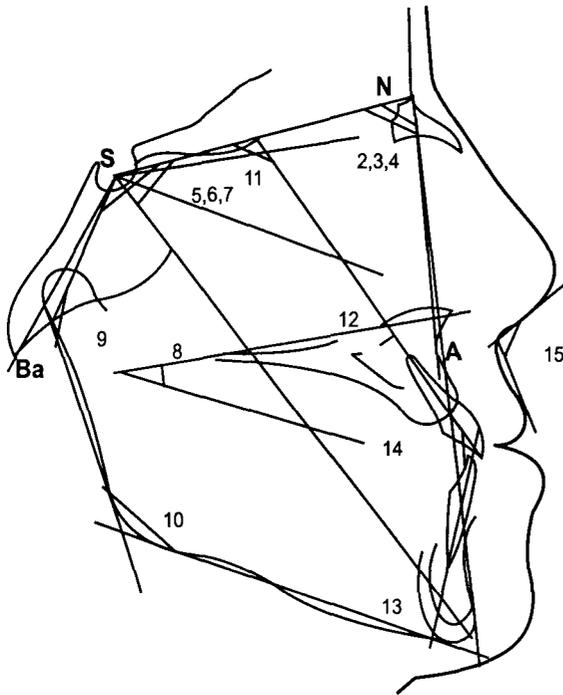


Fig. 2. Cephalometric Angular Measurements

1. N-S-Ba, 2. SNA, 3. SNB, 4. SN-Pg, 5. SN-PP, 6. SN-MP, 7. Y.axis (N-S-Gn) , 8. MMA (Maxillomandibular plane angle), 9. S-Ar-Go, 10. Ar-Go-Gn, 11. SN-UI, 12. PP-UI, 13. IMPA, 14. IIA, 15. NLA (Nasolabial angle).

RESULTS

Over all skeletal and dentoalveolar relations including cranial base, maxillary, mandibular, Intermaxillary, dentoalveolar and soft tissue measured in 50 patients of both gender were reviewed. The mean, standard deviation, standard error of means and range for all cephalometric variables of class III malocclusion are presented in Table 2. The comparative means, standard deviation

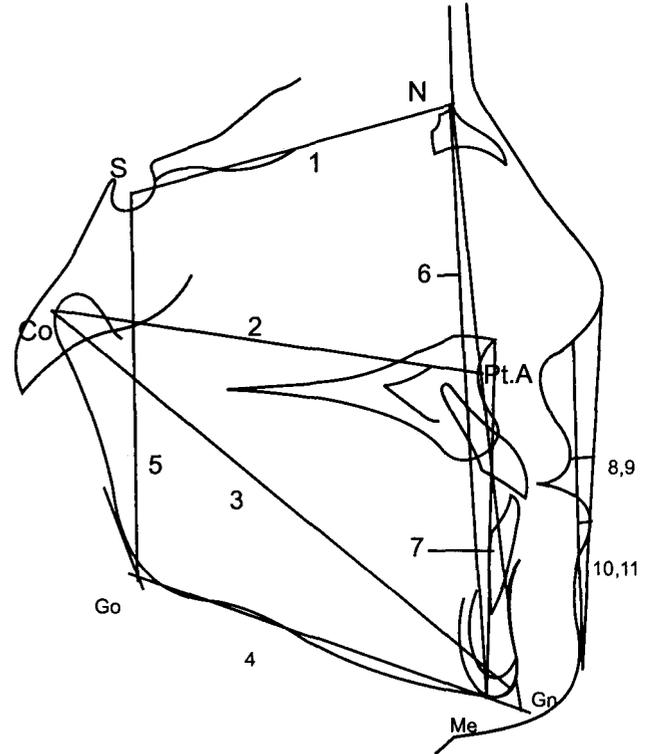


Fig. 3. Cephalometric Linear Measurements

1. S-N, 2. Co-Pt A, 3. Co-Gn, 4. Gn-Gn, 5. PFH (S-Go), 6. AFH (N-Me), 7. LAFH (ANS-Me), 8. UL-E. Line, 9. UL-S.line, 10. LL-E.line, 11. LL-S.line

and significance for males and females are summarized in Table 3.

Cranial Base Relationships

It is observed that the mean measurement of S-N was 72.08 ± 4.59 mm. On the other hand, the mean value of N-IIA(°for entire sample was $130.16^\circ \pm 6.16$. The mean value for cranial base length (S-N) in males

TABLE 2: CEPHALOMETRIC MEASUREMENTS FOR ENTIRE SAMPLE
(Cranial base, Maxillary, Mandibular, Intermaxillary, Dentoalveolar and Soft tissue)
n=50

Variable	Mean	SD	SEM	MIN	Max
S-N (mm)	72.08	4.59	0.65	65	82
N-S-Ba (°)	130.16	6.16	0.87	118	142
SNA (°)	78.94	4.09	0.58	70	88
SN-PP (°)	7.86	2.91	0.41	0	13
Co-Pt.A (mm)	87.46	5.42	0.77	78	97
SNB (°)	82.46	3.91	0.55	78	92
SN-Pog (°)	83.48	3.88	0.55	76	93
SN-MP (°)	33.66	6.58	0.93	18	48
Y-Axis (°)	66.98	3.45	0.49	60	73
S-Ar-Go (°)	140.60	7.45	1.05	128	154
Ar-Go-Gn (°)	125.90	5.61	0.79	115	140
Co-Gn(°)	126.32	10.43	1.48	109	155
Go-Gn (mm)	86.24	6.27	0.89	78	107
ANB (°)	-3.52	2.42	0.34	0	-9
MMA (°)	26.56	5.92	0.84	12	40
PFH/TAFH (%)	65.29	4.81	0.68	55.3	78.8
LAFH/TAFH(%)	57.96	3.76	0.53	52.55	76.60
UI-SN (°)	112.56	8.54	1.21	98	132
UI-PP (°)	119.68	8.94	1.26	109	143
IMPA (°)	85.68	6.01	0.85	76	103
HA (°)	127.90	8.53	1.21	111	140
UL-E (mm)	-7.64	3.24	0.46	0	-15
LL-E (mm)	-1.40	3.57	0.51	+5	-10
UL-S (mm)	-2.76	2.55	0.36	+2	-9
LL-S (mm)	1.54	2.77	0.39	+6	-5
NLA (°)	94.48	8.27	7.17	81	122

(74.56±4.20 mm) was higher than females (69.60±3.54 mm) at highly significant level of $p < 0.001$. The average values regarding N-S-Ba for male and female subjects were $128.76^\circ \pm 5.93$ and $131.56^\circ \pm 6.19$ with statistically insignificant difference (Tables 2 and 3).

Maxillary Relationships

The mean values for angular relationships for SNA and SN-PP were $78.94^\circ \pm 4.09$ and $7.86^\circ \pm 2.91$ respectively. Mean linear measurement of overall sample for Co-Pt.A was 87.46 ± 5.42 mm. The anteroposterior relation of maxilla to cranial base was determined by angle SNA with decreased value as compared to norms for class I relations suggestive of deficient maxilla in this

sample. The maxillary length Co-Pt A was also less as compared to normal value for class I subjects. The vertical relation of maxilla to cranial base shown by angle SN-PP was within normal range. The mean value for maxillary length (Co-Pt.A) in males (90.28 ± 5.88 mm) was 5.64 mm larger than LAFH/TAFH (84.64 ± 2.98 mm) at significance level of $p < 0.001$. The difference between male and females for SNA and SN-PP remained insignificant (Tables 2 and 3).

Mandibular Relationships

The mean angular degrees of SNB, SN-Pog, SNMP, Y-Axis, S-Ar-Go and S-Ar-Gn were $82.46^\circ \pm 3.91$, $83.48^\circ \pm 3.48$, $33.66^\circ \pm 6.58$, $66.98^\circ \pm 3.45$, $140.60^\circ \pm 7.45$ and

TABLE 3: CEPHALOMETRIC MEASUREMENTS FOR MALE AND FEMALE SAMPLE

(Cranial base, Maxillary, Mandibular, Intermaxillary, Dentoalveolar and Soft tissue)

n=50

Variable	MALE (25)		FEMALE (25)		Diff	Significance
	Mean	SD	Mean	SD	Diff	P-value
S-N (mm)	74.56	4.20	69.60	3.54	4.96	P<0.001
N-S-Ba (°)	128.76	5.93	131.56	6.19	2.80	NS
SNA (°)	79.84	3.70	78.04	4.33	1.80	NS
SN-PP (°)	8.48	2.52	7.24	3.19	1.24	NS
Co-Pt.A (mm)	90.28	5.88	84.64	2.98	5.64	P<0.001
SNB (°)	83.40	4.12	81.52	3.51	1.88	NS
SN-Pog (°)	84.40	4.19	82.56	3.37	1.84	NS
SN-MP (°)	32.48	6.62	34.84	6.46	2.36	NS
Y-Axis (°)	66.76	3.46	67.20	3.50	0.44	NS
S-Ar-Go (°)	139.28	8.64	141.92	5.92	2.64	NS
Ar-Go-Gn (°)	126.20	5.80	125.60	5.53	0.60	NS
Co-Gn (°)	130.04	11.76	122.60	7.42	7.44	P<0.01
Go-Gn (mm)	83.40	6.66	84.28	5.21	0.88	P<0.01
ANB (°)	-3.56	2.20	-3.48	2.66	0.08	NS
MMA(°)	24.60	6.06	28.52	5.17	3.92	P<0.01
PFH/TAFH(%)	66.32	4.63	64.25	4.86	2.07	NS
LAFH/TAFH(%)	57.91	4.61	58.01	2.75	0.10	NS
UI-SN (°)	114.92	8.55	110.20	8.02	4.72	P<0.01
UI-PP (°)	122.32	8.58	117.04	8.66	5.28	P<0.01
IMPA (°)	86.44	5.99	84.92	6.06	1.52	NS
IIA (°)	126.52	9.85	129.28	6.90	2.76	NS
UL-E (mm)	-7.92	3.53	-7.36	2.96	0.56	NS
LL-E (mm)	-1.20	3.63	-1.60	3.58	0.40	NS
UL-S (mm)	-2.72	2.97	-2.80	2.12	0.08	NS
LL-S (mm)	1.96	2.73	1.12	2.80	0.84	NS
NLA (°)	94.52	9.79	94.44	6.62	0.08	NS

125.90°±5.61. The average measurements of Co-Gn and Go-Gn were 126.32±10.43 mm and 86.24±6.27 mm (Table 2). The Comparison of males and females for Mandibular Skeletal Relationships was carried out. Mandibular Skeletal Relationships including SNB, SNPog, SN-MP, Y-Axis, S-Ar-Go and Ar-Go-Gn for males were 83.40°±4.12, 84.40°±4.19, 32.48°±6.62, 66.76°±3.46, 139.28°±8.64, 126.20°±5.80 degrees and those for females were 81.52°±3.51, 82.56°±3.37, 34.84°±6.46, 67.20°±3.50, 141.92°±5.92, 125.60°±5.53. It was observed that the angle of SNB, SN-Pog, and Y-Axis were more or less similar in both sexes. However the angle of SNMP showed variation among male and female patients

at significance level of p< 0.01. The mean values for CoGn and Go-Gn of males were 130.04±11.76mm, 83.40±6.66 mm and those for females were 122.60±7.42mm and 84.28±5.21mm. There was statistically significant difference at p<0.01 between male and female samples for Co-Gn and Go-Gn (Table 3).

Intermaxillary Relationships

The Inter-Maxillary Relationships include ANB (difference of SNA and SNB angles) and MMA (maxillary to mandibular plane angle). It is observed that mean angle of ANB and MMA was -3.52°±2.42 and 26.56°±5.92. The mean percentages of PFH/TAFH and

LAFH/TAFH of total subjects were $65.29 \pm 4.81\%$ and $57.96 \pm 3.76\%$ (Table 2). A Comparison of males and females for Inter-Maxillary Relationships was also carried out. It is observed that mean angle of ANB is quite similar in both sexes ($-3.56^\circ \pm 2.20$ and $-3.48^\circ \pm 2.66$) and their comparison shows no significant difference. On the other, the angle of MMA was significantly high ($P < 0.01$) in females ($28.52^\circ \pm 5.17$) as compared to male patients ($24.60^\circ \pm 6.06$) (Table 3). The mean ratio of PFH/AFH in males and females was $66.32\% \pm 2.07$ and $64.25\% \pm 4.86$ with statistically insignificant difference. The mean ratio of LAFH/AFH in males and females was $57.91\% \pm 4.617\%$ and $58.01\% \pm 2.75$ with statistically insignificant difference (Table 3).

Dentoalveolar Relationship

Dento-Alveolar relationships include the angles of UI-SN (Upper incisor-Sella Nasion plane), UI-PP (Upper incisor-Palatal/maxillary plane), IMPA (Lower incisor to mandibular plan angle) and IIA (inter incisor angle). It is observed that the mean angles of UI-SN and UI-PP were $112.56^\circ \pm 8.54$ and $119.68^\circ \pm 8.94$. The mean angles of IMPA and of IIA were $85.68^\circ \pm 6.01$ and $127.90 \pm 8.53^\circ$ (Table 2). It is also observed that the angle of UI-SN and UI-PP were smaller in female patients ($110.92^\circ \pm 8.02$ and $117.04^\circ \pm 8.66$) as compared to angles for male patients ($114.92^\circ \pm 8.55$ and $122.32^\circ \pm 8.58$) with significant difference ($P < 0.01$). The values for IMPA and IIA were also different in female ($84.92^\circ \pm 6.06$ and $129.28 \pm 6.90^\circ$) as compared to the angles of male ($86.44^\circ \pm 5.99$ and $126.52^\circ \pm 9.85$) but there was no significant difference (Table 3).

Soft tissues Relationships

Mean soft tissue relationship (UL-E, LL-E, UL-S and LL-S) in total patients was -7.64 ± 3.24 , -1.40 ± 3.57 , -2.76 ± 2.55 and 1.54 ± 2.77 mm. However, the mean nasolabial angle in whole subjects was $94.48^\circ \pm 8.27$ (Table 2).

Soft tissue relationships (UL-E, LL-E, UL-S and LL-S) in male / female subjects were figured (-7.92 mm ± 3.53 , -1.20 mm ± 3.63 , -2.72 mm ± 2.97 , 1.96 mm ± 2.73 and -7.36 mm ± 2.96 , -1.60 mm ± 3.58 , -2.80 mm ± 2.12 , 1.12 mm ± 2.80). An insignificantly higher soft tissue relationship was observed in female patients as compared to the male patients. A comparison of Nasolabial angle in both sexes ($94.52^\circ \pm 9.79$ and

94.44 ± 6.62) was also figured and found quite similar relationship in both sexes (Table 3).

DISCUSSION

The review of literature indicated that there was a need to evaluate Cephalometric characteristics of class III malocclusion in Pakistani population. So, this study was undertaken to disclose the morphologic characteristics of the craniofacial complex of Pakistani adults with class III malocclusion.

The antero-posterior relationship of maxilla to cranial base as shown by angle SNA for this sample was 78.94° , and this value is suggestive of class III relationship as compared to normal values of Steiner¹⁹ (82°) for the Caucasian population, Tajik¹⁷ (81.25°) for Pakistani population. Using angular analysis SNA; 54 % showed retrusive maxilla, 32% normally positioned while 14% prognathic maxillary relationship to cranial base. This confirmed that a retrusive maxilla in relation to cranial base is one of the etiologic factors for class III malocclusion. In linear analysis using Co-Pt.A, this sample showed 3.24 mm decreased length as compared to normal value for class I sample from Burlington Orthodontic research Centre. This further confirmed short maxillary length a feature of class III malocclusion.

The antero-posterior relationship of mandible to cranial base as shown by angle SNB for this sample was 82.46° , and this value is suggestive of class III relationship as compared to normal values of Steiner¹⁹ (80°) for the Caucasian population, Tajik¹⁷ (78.97°) for Pakistani population. Using angular analysis SNB; 62 % showed protrusive mandible, 34% normally positioned while 4% retrusive mandibular relationship to cranial base. This confirmed that a protrusive mandible in relation to cranial base is one of the etiologic factors for class III malocclusion.

The effective Mandibular length (Co-Gn) in males (130.04 mm) was 7.44 mm greater than females (122.60 mm). These values of effective Mandibular length for males and females of this sample are comparatively larger than Ann Arbor norms for normal well-balanced faces and good occlusion²⁰.

The Mandibular corpus length (86.24 mm) in this class III sample was 7.00 mm greater than X+7 that showed an increased length of the body of mandible as

compared to anterior cranial base length. As a comparison with Tajik's¹⁷ Norms (78.31), the body of mandible in our sample is 8 mm large suggestive of enlarged body of mandible.

In linear analysis, total Mandibular length and Mandibular corpus length showed much greater values than normal, which means that prognathic mandible act as a feature of class III malocclusion. These findings are similar to those observed by previous investigators^{3,14,15,21,22}. The males of this sample exhibited larger values for SNB, SN-Pog, Co-Gn, and Go-Gn than females.

Using angular measurements (SNB, SN-Pog), the males showed insignificantly larger values for antero-posterior relation of mandible to cranial base. But there were significantly ($p < 0.01$) larger values of linear measurements (Co-Gn, and Go-Gn) in males of this sample than females, which meant that males with class III malocclusion had larger antero-posterior size of mandible than females.

The mean value for SN-plane to mandibular plane angle, for gonial angle and for the Articulare angle was compared with normal occlusion values of a study", all these values fall in the normal range. This means that all the patients have normal growth pattern and vertical relationship to cranial base. The females of this sample showed higher values for SN-MP, Y-axis, Gonial angle, and Articulare angle than males. This means that females with class III malocclusion have slightly vertical growth pattern while males shows normal growth pattern.

The mean value of ANB angle for entire sample was less than normal value of a study¹⁹, and also significantly less than that value for ANB in the normal occlusion sample of a pollster". This value is suggestive of class III relationship between maxillary and mandibular apical bases. The analysis of ANB angle revealed that 96% of the sample exhibited class III relationship. A retrusive maxilla and an overdeveloped and prognathic mandible caused this significant underlying skeletal discrepancy. The mean value for the ANB angle in males/females showed an insignificant difference of 0.08° . However the mean value of maxillary-mandibular plane angle shows normal relationship of maxilla and mandible in vertical plane for this sample.

The mean value of maxillary-mandibular plane (MMA) angle in males/females showed that females have more vertical pattern of growth than males. This also confirmed the tendency toward vertical growth in females exhibited by Mandibular angular measurements for vertical relationships.

The dento-alveolar measurements were taken for UI-SN plane, UI to PP, LI to MP (IMPA), and Interincisal angle (IIA). These values are more than normal range, which means that upper incisors are proclined due to dental compensation in class III subjects. These results are in consistent with other studies^{9, 22,23,24}. The mean values for UI to SN plane in males and females showed that females of this sample have significantly less proclination of upper incisors. Similarly the mean value of UI-PP angle for the males and females confirmed that females have less incisor proclination as compared to males with a significant difference.

The mean value for the lower incisor to mandibular plane angle showed a lower value. This lower value is suggestive of mandibular incisor's retrusion as a result of dental compensation to underlying skeletal discrepancy. The mean value for interincisal angle (IIA) of entire sample is slightly more than normal occlusion value of investigator¹⁷ and less than the study of normal value of another investigator¹⁹. This showed that there is less change in IIA due to upper and lower incisors compensation.

CONCLUSIONS

It is therefore concluded that regarding the Cephalometric characteristics of Pakistani patients with class III malocclusion;

1. The maxilla showed retrusive relation to cranial base antero posteriorly for both angular and linear measurements
2. The Mandible showed prognathism in relation to cranial base both for angular and linear parameters in antero-posterior relationship.
3. The Dento-alveolar measurements showed maxillary incisors proclination and mandibular incisors retroclination, suggestive of dental compensation to skeletal discrepancy.

4. Males exhibited more dominant anteroposterior dysplasia while females showed more vertical growth tendency.

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