



Establishing the Cephalometric Values for Tetragon Analysis in Patients with Class I Occlusion: A Cephalometric Study

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ABSTRACT

Objectives: Proper application of the cephalometric norms for tetragon analysis for better understanding, diagnosis, and management of dentofacial deformities in the ethnic population.

Materials and methods: A total of 204 subjects, inclusive of males (102) and females (102), were selected randomly from the outpatient department of Saveetha Dental College and Hospitals, in the age group ranging from 18 to 25 years, fulfilling the inclusion criteria.

Assessment of each lateral cephalogram was done using tetragon analysis to evaluate the cephalometric values for individuals with class I occlusion using the FACAD[®] 3.4.0.3 A software.

Results: Statistically significant differences were found for all parameters between the ethnic population and the Caucasian norms. Four out of 14 parameters were found to be significantly different between male and female in the ethnic population.

Conclusion: This study indicates that the local ethnic population have more prognathic maxillary and mandibular jaws, converging tendency of the jaw bases (resulting in reduced lower anterior facial height and horizontal growth pattern) as indicated by the analysis done in the tetragon and the trigon, and increased proclination of the upper and lower incisors.

Keywords: Caucasians, Cephalometrics, Ethnic population, Tetragon analysis.

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INTRODUCTION

Roentgenographic cephalometry was first developed as a tool to study craniofacial growth and development. Gradually with time, the use of cephalometry extended to the study of facial form and development of norms to define the objectives of orthodontic treatment. These uses later expanded to include the surgical prediction, assessment of treatment progress, and growth prediction. With the widespread use of cephalometry in diagnosis and treatment planning, it became apparent that the widely studied Caucasian norms in different cephalometric analyses were inadequate for application to different racial and ethnic groups.¹

Cephalometric studies by different investigators clearly revealed that the normal measurements of one group should not be considered normal for other racial groups.²⁻⁵ Different racial groups must be treated according to their own individual characteristics.

The purposes of the present study were (1) to establish the cephalometric norms of tetragon analysis for ethnic population with normal class I occlusion and (2) to investigate the gender differences between male and female subjects.

MATERIALS AND METHODS

A total of 204 lateral cephalograms (102 males and 102 females) were collected in the age group of 18 to 25 years from the ethnic population. The selection criteria for the sample were (1) Angle's class I molar relation,

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(2) individuals in the age group of 18 to 25 years, (3) full complement of erupted teeth up to second molar, (4) no history of orthodontics treatment, (5) no crowding or crossbite in anterior/posterior segment, and (6) normal overjet and overbite. Each lateral cephalogram was recorded in natural head position with Planmeca Promax digital X-ray unit.

Statistical calculations were made by Statistical Package for the Social Sciences (SPSS) 15 software in means, standard deviations, median, and "t" test. Thirty random samples were selected and retraced to evaluate method error using Dahlberg's method. No significant differences were found in any parameter.

The landmarks and reference lines for the tetragon analysis were traced digitally on FACAD 3.4.0.3, a software (Fig. 1).

Lines or Planes Used in Tetragon Analysis are:

- SN: Sella – Nasion.
- NA: Nasion – Point A
- NB: Nasion – Point B
- Pt.-Or: Pterygomaxillary fissure/Pt. Point – Orbitale
- PP: PNS – ANS

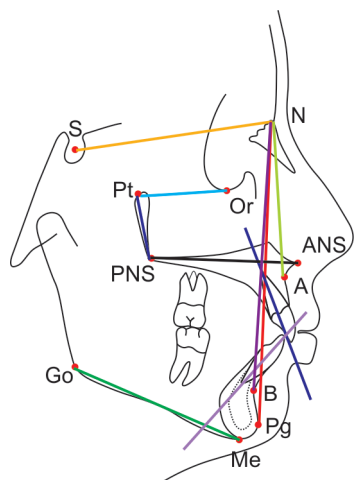


Fig. 1: Lines and planes

- UI: Long axis of upper incisor
- LI: Long axis of lower incisor
- Pt – PNS: Pt. Point to PNS
- MP: Gonion to Menton
- N-Pg: Nasion – Pogonion.

RESULTS

Table 1 represents the mean, standard deviation and median values for the cephalometric values for group 1 (102 males with class I malocclusion).

Table 2 represents the mean, standard deviation and median values for the cephalometric values for group 2 (102 females with class I malocclusion).

Table 3 represents the comparison of cephalometric values for each individual of groups 1 and 2 and a Student's "t" test was carried out to determine the significance of difference in the values.

Table 4 represents the comparison of cephalometric values between Caucasian population and male and female groups of ethnic population and a Student's t-test was carried out to determine the significance of difference in the values.

Significant differences were found between the group 1 (male) and group 2 (female) in ethnic population in 4 of the 14 total parameters, namely, Pt.-Or/PNS, Pt.-PNS/PP, U1-PP, and L1-MP.

The differences between the cephalometric norms of Caucasian norms and the ethnic population were found to be highly significant for all parameters in both male and female groups.

DISCUSSION

Tetragon

- The present study showed that the upper and lower incisors were more proclined in the ethnic population

Table 1: Cephalometric values for tetragon analysis for group 1 (males class I malocclusion)

		Mean	SD	Median
Tetragon measurements (angles)	U1-PP	117.2	5.671	117.55
	U1-L1	125.1	8.325	124.25
	L1-MP	96.50	5.862	96.6
	MP-PP	21.20	7.398	20
Trigon measurements (angles)	Pt.-Or/PNS	72.9	6.23	72.95
	Pt.-PNS/PP	99.6	11.57	100.15
	Pt.-Or/PP	7.5	2.95	7.4
Other angles	SNA	84.08	3.13	85.0
	SNB	81.46	2.64	81.5
	ANB	3.37	1.416	3.2
N-Pg/U1 (linear)		5.81	1.76	5.85
N-Pg/L1 (linear)		3.19	1.77	3.45
U1-PP (linear)		25.87	3.06	25.8
L1-MP (linear)		38.40	4.44	38.3

Table 2: Cephalometric values for tetragon analysis for group 2 (females class I malocclusion)

		Mean	SD	Median
Tetragon measurements (angles)	U1-PP	117.9	5.66	118.7
	U1-L1	124.09	7.66	123.05
	L1-MP	96.08	7.20	96.3
	MP-PP	21.93	5.06	21.75
Trigon measurements (angles)	Pt.-Or/PNS	70.21	6.62	70.55
	Pt.-PNS/PP	102.07	6.53	101.5
	Pt.-Or/PP	7.72	3.87	7.65
Other angles	SNA	83.87	2.24	84
	SNB	80.75	2.57	81.3
	ANB	3.14	1.20	3.1
N-Pg/U1 (linear)		5.78	1.99	6
N-Pg/L1 (linear)		3.22	1.98	3.2
U1-PP (linear)		24.86	2.91	25.2
L1-MP (linear)		35.76	3.52	36.5

Table 3: Comparison of group 1 (male) and group 2 (females)

Measurements	Group 1 (male)		Group 2 (female)		p-value	Significance
	Mean	SD	Mean	SD		
U1-PP	117.2	5.671	117.9	5.66	0.382	NS
U1-L1	125.1	8.325	124.09	7.66	0.335	NS
L1-MP	96.50	5.862	96.08	7.20	0.634	NS
MP-PP	21.20	7.398	21.93	5.06	0.709	NS
Pt-Or/PNS	72.9	6.23	70.21	6.62	0.008	S
Pt-PNS/PP	99.6	11.57	102.07	6.53	0.043	S
Pt-Or/PP	7.5	2.95	7.719	3.87	0.440	NS
SNA	84.08	3.13	83.87	2.24	0.802	NS
SNB	81.46	2.64	80.75	2.57	0.052	NS
ANB	3.37	1.416	3.14	1.20	0.216	NS
N-Pg/U1	5.81	1.76	5.78	1.99	0.891	NS
N-Pg/L1	3.19	1.77	3.22	1.98	0.902	NS
U1-PP	25.87	3.06	24.86	2.91	0.017	S
L1-MP	38.40	4.44	35.76	3.52	0.00	S

NS: Nonsignificant; S: Significant

Table 4: Comparison of caucasian norms with male and female in ethnic population

Measurement	Caucasian norms	Male (ethnic)		Female (ethnic)		p-value
		Mean	SD	Mean	SD	
PP-U1	113	117.2	5.67	117.9	5.66	<0.0001
U1-L1	128	125.1	8.32	124.09	7.66	<0.0001
L1-MP	93	96.5	5.86	96.08	7.2	<0.0001
PP-MP	26	21.2	7.39	21.93	5.06	<0.0001
Pt-Or/PNS	81	72.9	6.23	70.21	6.62	<0.0001
Pt-PNS/PP	90	99.6	11.57	102.07	6.53	<0.0001
Pt-Or/PP	9	7.5	2.95	7.72	3.87	<0.0001
SNA	82	84.08	3.13	83.87	2.24	<0.0001
SNB	80	81.46	2.64	80.75	2.57	<0.0001
ANB	2	3.37	1.416	3.14	1.2	<0.0001
N-Pg/U1	2	5.81	1.76	5.78	1.99	<0.0001
N-Pg/L1	1	3.19	1.77	3.22	1.98	<0.0001
U1-PP	34	25.87	3.06	24.86	2.91	<0.0001
L1-MP	43	38.4	4.44	35.76	3.52	<0.0001

represented by increased upper incisors to palatal plane angle, increased lower incisors to mandibular planes angle, and decreased interincisal angle. This finding is in concurrence with the findings of the studies carried out by Valiathan^{6,7} and Nanda and Nanda.⁴

- This study reveals that the mandibular plane to palatal plane angulation is reduced in the ethnic population.^{8,9} This implies a converging tendency of maxillary and mandibular jaw bases, tendency of reduced lower anterior facial height, and horizontal growth pattern.^{10,11}

Trigon

This study reveals that there is an increase in the angulation of Pt-PNS/PP and decrease in the angulation of Pt-Or/PP, indicating that there is clockwise rotation of palatal plane. According to Fastlicht,¹² if the palatal plane is tipped cranially (anticlockwise), the tetragon will also tip cranially and if palatal plane tips caudally (clockwise), the tetragon will also tip caudally.

However, in our study, the palatal plane has been found to tip clockwise and the tetragon in anticlockwise direction. This is in accordance with the study done by Prakash et al,¹³ who explain this by considering that the posterior aspect of the maxilla is more superiorly placed as compared to anterior aspect, thus tipping the palatal plane in the clockwise direction. This phenomenon causes an overclosure of the mandible, thus rotating it in upward and forward direction. This causes the tipping of trigon and tetragon in opposite directions.

Other Angles (SNA, SNB, and ANB)

This study reveals that both maxillary and mandibular jaw bases are more prognathic in both males and females in ethnic population. This is shown by an increase in the value of the SNA and SNB angles as compared to the Caucasian population. The inference is in accordance with the findings of John and Valiathan.¹⁴

This study also reveals that the value of maxillary and mandibular (maxillomandibular) base in relation to each other is increased in ethnic groups with normal occlusion in both males and females when compared with the Caucasian and Hispanics groups. This is in accordance with the study conducted by Nabanita and Mitali¹⁵ and Grover.¹⁶

Linear Measurements: (N-Pg/U1, N-Pg/L1, U1/PP, and L1-MP)

In this study, it was found that the maxillary central incisors and mandibular central incisors are more proclined in our ethnic population shown by increased value of N-Pg/U1 and N-Pg/L1 respectively, in both male and female groups. This finding is in concurrence with the findings of Valiathan,⁶⁻⁸ Nanda and Nanda,⁴ John and Valiathan,¹⁴ Nabanita and Mitali,¹⁵ Arunkumar and Reddy⁹ and Grover.¹⁶

Our study indicated that the central incisors in both maxilla (U1-PP) and mandible (L1-MP) are infra erupted in ethnic population as compared to the Caucasian norms^{12,17} in both male and female groups.

CONCLUSION

- Maxillary and mandibular jaws are more prognathic with regard to cranial base in local population.
- Maxillary and mandibular jaws have converging tendency toward each other in the local population, implying reduced lower anterior facial height and a tendency for horizontal growth pattern with clockwise rotation of maxilla (increased caudal tipping was seen in female population).
- The upper and lower incisors are more proclined in the ethnic population as compared to the Caucasian or Hispanic population (as described by Fastlicht¹²).
- The upper and lower incisors are infra erupted, with females having less eruption than males.

The results of this study support the fact that norms and standards of one racial group cannot be used without modification for other racial groups and each racial group has to be treated according to its individual characteristics.

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