ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 2, April - 2020, Page No. : 201 - 210

Quadrilateral Analysis Applied To Chennai Population with Deep Bite

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Citation of this Article: Dr. Dhivya Dilip kumar, Dr. R. Suga Priya, Dr. Poonkuzhali Suresh, Dr. Dhinahar, Dr. Deenadayalan Purushothaman, Akshay Tandon, "Quadrilateral Analysis Applied To Chennai Population with Deep Bite ", IJDSIR- April - 2020, Vol. – 3, Issue -2, P. No. 201 – 210.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

The aim of this study was to apply the quadrilateral analysis to Chennai population with normal occlusion and to evaluate the correlation of the quadrilateral variables. The study was carried out from the values taken from pretreatment lateral cephalograms of the selected Chennai population and divided into 2 groups .Group A consists of lateral cephalograms of patient with balanced anteroposterior and vertical facial proportion. Normal overjet and overbite relationship. Group B consists of lateral cephalograms of patient with anterior deep bite. A quadrilateral analysis of the craniofacial structures of Chennai population with normal overjet and overbite were compared to Chennai population with anterior deep bite. The results showed that patient with anterior deep bite have smaller sagittal angle,the maxillary and mandibular sagittal ratio with decreased lower facial height and sagittal ratio.

Keywords: Quadrilateral analysis, Chennai population, overjet, overbite, deepbite,cephalometric radiography

Introduction

The quadrilateral analysis was introduced by Di Paolo[1] to relate the cephalometric 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 baselength ,mandibular base length ,average of anterior facial height and posterior facial height in a balanced facial pattern [2-5].Tseng and Kao et al [6,7]also advocated that the quadrilateral analysis is a valuable cephalometric tool for diagnosis and treatment planning of orthodontic problems.

Four linear measurements forms a quadrilateral .These are the maxillary base length, mandibular base length, anterior facial height and the posterior facial height[5].

Cephalometrics play a vital role in describing the craniofacial pattern evaluating the changes due to growth, proper diagnosis, obtaining appropriate treatment objective and treatment planning. It can be used to predict the expected changes during growth [8-10].

The prevalence of anterior deep bite varies among ethnic groups, age, and dentition[11-12]. Understanding the differences in craniofacial structures between normal and deepbite is important for clinical management and research purposes. Cephalometric comparisons highlight the differences in craniofacial structure.

Trouten etal[13] studied the morphologic factors in deep bite and open bite patients. It was revealed that deep bite malocclusion was associated with decreased gonial angle, deep curve of spee, decreased posterior maxillary dimension, downward rotation of the palatal plane, and more forward position of the ramus. Beckmann et al [13, 14] assessed the alveolar and skeletal dimension associated with overbite and lower facial height. They suggested that a deep overbite coincided with smaller lower facial height, larger anterior alveolar and basal areas and retroclination of maxillary incisors. Bydass et al [15] studied the effect of the depth of curve of spee on overbite and overjet. Increased overbite was observed in the deep curve of spee caused by extruded lower anterior teeth.

Therefore, the aims of this study were:

(1) To apply the quadrilateral analysis to Chennai population with normal occlusion

(2) To evaluate the correlation of the quadrilateral variables.

Materials & methods

The study was carried out from the values taken from pretreatment lateral cephalograms of the selected Chennai population. (Group A and group B)

Group A: 30 lateral cephalograms from people with normal occlusion.

Inclusion criteria for group A: Age group of 15-25years.

Normal occlusion

Balanced anteroposterior and vertical facial proportion

Normal overjet and overbite

Normal skeletal relationship

Overbite depth indicator more than 68° and less than 80°

No history of trauma, jaw fracture, cleft or craniofacial syndrome

No previous orthodontic treatment

Group B: 30 lateral cephalograms from patients with anterior deep bite

Inclusion criteria for group B: Age group of 15-25 years.

1mm or more of anterior deep bite measured as a perpendicular vertical distance from the tip of the mandibular incisal edge to the horizontal line passing through the tip of the upper incisal edge.

Greater than 68° of over bite depth indicator [ODI].

For the final selection of the deep bite group, each patient must be 20 years and above, upper and lower first molars should be present with the posterior teeth in occlusion

No history of orthodontic treatment or craniofacial trauma.

Cephalometric parameters

The following landmarks were identified on the tracing for the quadrilateral analysis and to measure the overbite depth indicator. (1) nasion (2) Sella turcica (3) orbitale (4) porion (5) anterior nasal spine (6) posteriornasal spine (7)

gonion (8) menton (9) gnathion (10) point A (11) point B (12) point A' (13) point B' (14) point C' (15) point D' (16) point J. If the landmarks were bilateral and did not coincide with each other on the tracing, the midpoint was chosen. The landmarks used in this study follow those used by DiPaolo. (Fig 1)

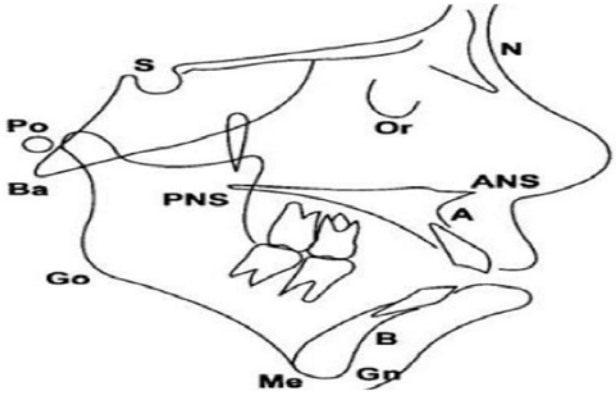

Fig.1

From the above landmarks the following cephalometric variables were measured:

MaxL. The maxillary base length measured in millimeters as the horizontal distance between two points (point A' and point C') projected onto the palatal plane. Point A' is a perpendicular from point A upward to the palatal plane. Point C' is a perpendicular from the most inferior portion of the pterygomaxillary fissure downward to the palatal plane.(fig 2)

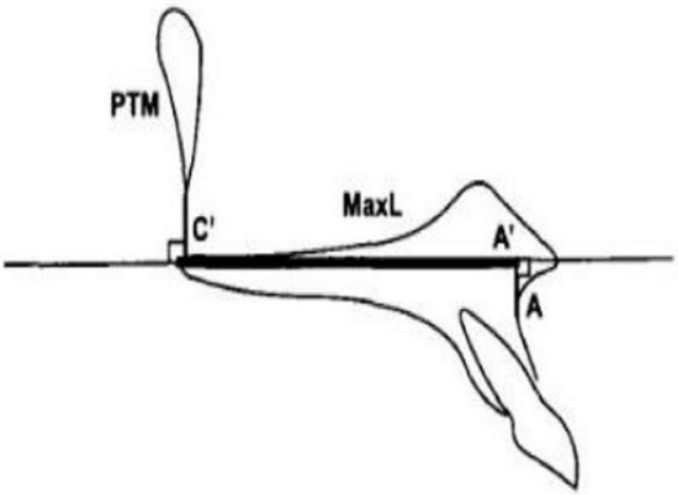

Fig. 2

ManL. The mandibular base length measured in millimeters between two points (point B' and point D') projected onto the mandibular plane. Point B' is a perpendicular from point B, while point D' is a perpendicular from point J downward to the mandibular plane. Point J is located at the deepest point of the junction of anterior portion of the ramus and the base of the mandible (Fig. 3).

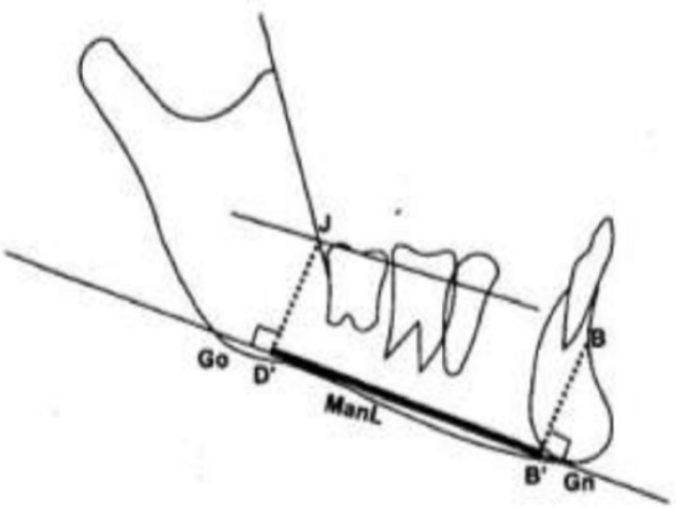

Fig. 3

ALFH. The anterior lower facial height measured in millimeters from point A' to point B' (Fig. 4).

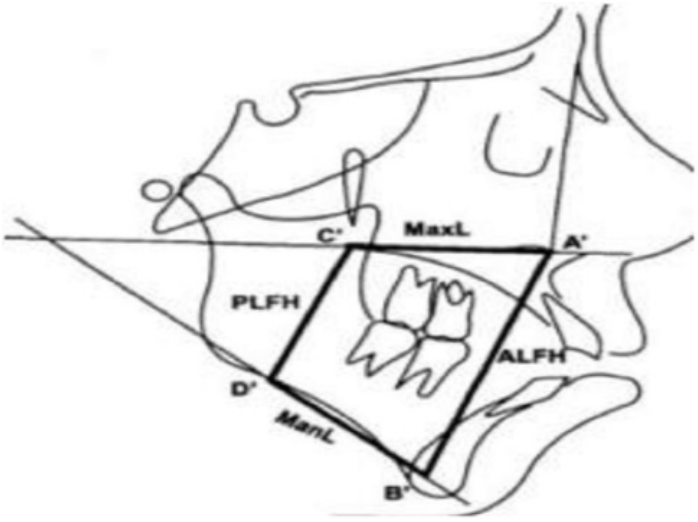

Fig. 4

PLFH. The posterior lower facial height measured in millimeters from point C' to point D' (Fig 4). These four measures (maxillary base length, mandibular base length, anterior lower facial height, and the posterior lower facial

height) form the basis of the quadrilateral analysis (Fig. 5).

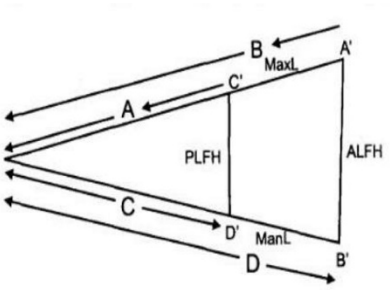

Fig. 5

SagAng. The sagittal angle, is the angle formed by the intersection of the posterior extension of the maxillary base and mandibular base.

ALFH/PLFH. The ratio of anterior lower facial height to the posterior lower facial height.

AUFH/TAFH. The ratio of anterior upper facial height to the total anterior facial height.

LFHaverage. The average of the lower anterior facial height and the lower posterior facial height.

UFAng. The upper facial angle. The angle between the line of the maxillary base length and the N-point A' line. It assesses the position of the maxilla.

FConvAng. The angle of facial convexity formed by the line N-A' and the line A'-B' measured at point A'. It relates the quadrilateral to the upper face and gives assessment of the skeletal profile.

AUFH. The anterior upper facial height measured in millimeters from point A' to point nasion.

(MaxL+MaxE)/MaxE. The maxillary sagittal ratio, the sagittal ratio is a mathematical expression to assess the relative anteroposterior positioning of the maxillary and mandibular bases (Fig. 5). The ratio of A to B is called the maxillary sagittal ratio.

(ManL+ManE)/ManE. The mandibular sagittal ratio, the ratio of C to D is called the mandibular sagittal ratio (Fig. 5). Any forward or retroposition of the base will cause unequal lengths of the posterior legs (lines A and C).

MaxE. The maxillary extension. Posterior extension of maxillary base length.

ManE The mandibular extension, Posterior extension of mandibular base length. The maxillary and mandibular posterior extensions of base lengths determine if there is any sagittal malrelation of the mandibular base to the maxillary base.

TPFH/TAFH. The ratio of total posterior facial height to total anterior facial height.

ALFH/TAFH. The ratio of anterior lower facial height to the total anterior facial height.

MaxL/ManL. The ratio of maxillary base length to mandibular base length.

MaxL/LFHaverage. The ratio of maxillary base length to the average of lower anterior and posterior facial heights.

MaxE/ManE. The ratio of maxillary posterior extension to the mandibular posterior extension.

TAFH. Total anterior facial height measured in millimeters as a combination of the lower anterior facial height and the upper anterior facial height.

TPFH. The total posterior facial height measured in millimeters from point gonion to sella turcica.

ODI. The overbite depth indicator (ODI) is a combination of the angle between the AB plane to mandibular plane and the angle between the Frankfort planes to palatal plane.

Statistical analysis

The collected data were analyzed with IBM.SPSS statistic software 23.0 version; to describe statistics mean and standard deviation were used. To find the significant difference between the bivariate samples in independent groups the Unpaired sample t test was used. To assess relationship Pearson's Correlation was used. In all the above statistical tools the

probability value .05 is considered as significant level.

Results

The results of the study showed statistical significance difference between the normal occlusion and anterior deepbite group (Table 1).

Table 1

Group Statistics

Groups		N	Mean	Std. Deviation	Std. Error Mean
Maxillary length	Deep bite	30	50.70	2.04	0.37
	Normal	30	52.17	3.14	0.57
Mandibular length	Deep bite	30	56.10	4.56	0.83
	Normal	30	54.07	4.71	0.86
ALFH	Deep bite	30	68.00	7.28	1.33
	Normal	30	57.47	5.41	0.99
PLFH	Deep bite	30	47.60	4.64	0.85
	Normal	30	46.33	4.50	0.82
SAG ANG	Deep bite	30	22.40	4.77	0.87
	Normal	30	12.47	5.34	0.98
ALFH/PLFH	Deep bite	30	1.43	0.13	0.02
	Normal	30	1.24	0.14	0.03
AUFH/TAFH	Deep bite	30	0.42	0.03	0.00
	Normal	30	0.47	0.03	0.01
LFH AVG	Deep bite	30	57.95	5.55	1.01
	Normal	30	52.07	3.94	0.72
UF AVG	Deep bite	30	89.60	2.46	0.45
	Normal	30	88.13	3.21	0.59
F CON AVG	Deep bite	30	173.30	3.25	0.59
	Normal	30	170.07	4.47	0.82
AUFH	Deep bite	30	50.60	2.37	0.43
	Normal	30	51.37	4.31	0.79
MAXL+MAXE/MAX E	Deep bite	30	1.44	0.10	0.02
	Normal	30	1.87	0.06	0.01
MANL+MANE/MANE	Deep bite	30	1.48	0.13	0.02
	Normal	30	1.73	0.04	0.01
MAX E	Deep bite	30	120.00	26.82	4.90
	Normal	30	59.60	3.02	0.55
MAN E	Deep bite	30	122.70	23.78	4.34
	Normal	30	74.60	2.58	0.47
TPFH/TAFH	Deep bite	30	0.85	0.31	0.06
	Normal	30	0.77	0.06	0.01
ALFH/TAFH	Deep bite	30	0.57	0.03	0.01
	Normal	30	0.53	0.03	0.00
MAXL/MANL	Deep bite	30	4.02	17.00	3.10
	Normal	30	0.97	0.05	0.01
MAXL/LFH	Deep bite	30	0.86	0.11	0.02
	Normal	30	1.01	0.08	0.01
MAX E/MANE	Deep bite	30	34.44	183.31	33.47
	Normal	30	0.81	0.06	0.01
TAFH	Deep bite	30	118.80	8.84	1.61
	Normal	30	109.70	7.68	1.40
TPFH	Deep bite	30	83.70	16.85	3.08
	Normal	30	84.10	6.98	1.27
ODI	Deep bite	30	75.00	3.25	0.59
	Normal	30	85.50	9.51	1.74

Discussion

The study applied the quadrilateral analysis to Chennai adult patients presenting with a normal occlusion and anterior deep bite.

The main finding in the Chennai adult with normal occlusion and balanced facial proportion was that the

length of the maxillary base equals to the length of mandibular base and equals to average lower anterior and posterior facial heights. This finding agrees with DiPaolo [1-5] and supports the hypothesis of equality put forward by the quadrilateral analysis.

Comparing the quadrilateral analysis of the normal occlusion group to the subjects with anterior deep bite (table 2) showed that the length of maxillary base and mandibular base were larger in the deep bite group. This was in agreement with DiPaolo et al[1, 2], Chinappi et al[3], DiPaolo et al[4-5], and Kao et al [21] who found that length of the maxillary and mandibular bases were larger in the deep bite subjects.

Table 2

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Maxillary length	Equal variances assumed	4.653	.035	-2.146	58	.036	-1.46667	.68352	-2.83489	-.09845
	Equal variances not assumed			-2.146	49.721	.037	-1.46667	.68352	-2.83975	-.09358
Mandibular length	Equal variances assumed	1.697	.198	1.699	58	.095	2.03333	1.19701	-.36274	4.42941
	Equal variances not assumed			1.699	57.937	.095	2.03333	1.19701	-.36280	4.42947
ALFH	Equal variances assumed	1.649	.204	6.364	58	.0005	10.53333	1.65518	7.22013	13.84653
	Equal variances not assumed			6.364	53.533	.000	10.53333	1.65518	7.21424	13.85243
PLFH	Equal variances assumed	.617	.435	1.073	58	.288	1.26667	1.18023	-1.09583	3.62916
	Equal variances not assumed			1.073	57.941	.288	1.26667	1.18023	-1.09588	3.62921
SAG ANG	Equal variances assumed	.693	.408	7.594	58	.0005	9.93333	1.30809	7.31490	12.55177
	Equal variances not assumed			7.594	57.285	.000	9.93333	1.30809	7.31420	12.55246

ALFH/PLFH	Equal variances assumed	3.054	.086	5.527	58	.0005	.19000	.03438	.12118	.25882
	Equal variances not assumed			5.527	57.597	.000	.19000	.03438	.12117	.25883
AUFH/TAFH	Equal variances assumed	.008	.931	-6.853	58	.0005	-.04800	.00700	-.06202	-.03398
	Equal variances not assumed			-6.853	57.973	.000	-.04800	.00700	-.06202	-.03398
LFH AVG	Equal variances assumed	4.268	.043	4.735	58	.000	5.88333	1.24247	3.39626	8.37040
	Equal variances not assumed			4.735	52.302	.0005	5.88333	1.24247	3.39048	8.37618

The lower anterior facial height was significantly smaller in deep bite patients compared to normal patients whereas the lower posterior facial heights were similar in the deep bite and normal patients. This was in agreement with several investigators20 who showed that the anterior deep bite patients have excessively decreased lower facial height. The sagittal angle was smaller in the anterior deep bite subjects. This was in agreement with DiPaolo et al2, Chinappi et al3, DiPaolo et al, and Kao et al21.The sagittal angle is formed by the intersection of the extensions of the maxilla and lower legs of the quadrilateral. The side legs of the quadrilateral are the anterior and posterior facial heights. An excessive increase in the lower facial heights will result in an increase in the sagittal angle. This is true if the posterior lower facial height was reduced or within normal range.The upper facial angle, that is, the angle formed by the palatal line and the line from point A' to point N measured at point A', was small in the anterior deepbite group compared to normal. It was suggested that this angle will estimate the position of the maxillae5. However, a large upper facial angle indicates a retruded maxilla or anterior upward tilting of maxilla and or posterior downward tilting of maxilla. This was in agreement with several investigators21, 28-38. However, the small size maxilla in the deepbite sample might affect the anteroposterior position of the maxilla. There was no change in convexity angle between deepbite group & control group.Correlation analysis of the measured variables ranged from 0.00 to 0.97. Wardlaw showed that the overbite depth indicator (ODI) is the most valuable parameter in diagnosing anterior deep bite tendency. The larger the ODI, the higher is the tendency for deepbite. There were high correlations with significant differences at $P<0.01$ between the ODI and the maxillary base length, anterior lower facial height, sagittal angle, facial angle and total facial height.The maxillary base length correlation analysis showed that in patients with a deepbite tendency, the larger the maxillary base length, the larger the mandibular base length, the larger the upper facial angle, the larger the maxillary posterior extension, the larger mandibular posterior extension. However, a significant negative correlation indicated that the smaller the maxillary base length the larger the sagittal angle. This is in agreement with Kao et

al.The anterior lower facial height correlation analysis showed a positive significant correlation with the posterior lower facial height, sagittal angle, upper facial angle, and total anterior facial height. The strongest correlation was between the anterior lower facial height and the total anterior facial height. This is in agreement with Kao et al21. Greater the decrease in anterior facial height, greater the decrease in total facial height and the sagittal angle.However, the anterior lower facial height negatively correlates with maxillary posterior extension, mandibular posterior extension and the ODI. On the other hand, the posterior lower facial height correlates positively with the anterior lower facial height, maxillary posterior extension, mandibular posterior extension and the total posterior facial height. The posterior lower facial height negatively correlates with the sagittal angle. The smaller the posterior lower facial height the larger the sagittal angle.The total anterior facial height correlation analysis showed positive significant correlation with anterior lower facial height, sagittal angle, upper facial angle, facial convexity angle, and upper anterior facial height. However, the total anterior facial height negatively correlates with the maxillary posterior extension, mandibular posterior extension, and the ODI. The total posterior facial height correlation analysis showed positive significant correlation with posterior lower facial height, facial convexity angle, maxillary posterior extension, and mandibular posterior extension. However, the total posterior facial height correlates negatively with the sagittal angle. These finding were in agreement with Kao et al21.The sagittal angle correlation analysis showed a positive significant correlation between the sagittal angle and anterior lower facial height, the upper facial angle, and the total facial height. In the deepbite tendency the smaller the sagittal angle the smaller the anterior lower facial height, the upper facial angle, and the total facial height. This was in agreement with DiPaolo et al 2, Chinappi et al3, DiPaolo et al 4, 5 and Kao et al21. However, the sagittal angle negatively correlate with maxillary base length, facial convexity angle, maxillary posterior extension, mandibular posterior extension, the total posterior facial height and the ODI. In the anterior deepbite patients, the smaller the sagittal angle the larger the maxillary base length, the facial convexity angle, the maxillary posterior extension, the mandibular posterior extension, the total posterior facial height, and the ODI. This agreed with Kao et al22.The upper facial angle correlation analysis showed positive significant correlation with the maxillary base length, anterior lower facial height, sagittal angle, facial convexity angle, and total anterior facial height. The positive significant correlation of the upper facial angle indicated that in deepbite patients, the greater the upper facial angle the greater the maxillary base length, the anterior lower facial height, the sagittal angle, the facial convexity angle, and the total anterior facial height. The facial convexity angle correlation analysis showed a positive significant correlation with posterior lower facial height, upper facial angle, maxillary posterior extension, mandibular posterior extension, and total anterior facial height. However, the facial convexity angle correlated negatively with the ODI.In the deepbite patients the smaller the sagittal angle the larger the maxillary base length, the facial convexity angle, the maxillary posterior extension, the mandibular posterior extension, the total posterior facial height, and the ODI. This was in agreement with DiPaolo et al2, Chinappi et al3, DiPaolo et al4, 5, and Kao et al21. The maxillary and mandibular posterior extensions have positive significant correlation with the maxillary base length, posterior lower facial height, facial convexity angle, and total anterior facial height. However, the correlation analysis showed a negative significant

correlation with the sagittal angle and the total anterior facial height.The correlation analysis of the deep bite patients indicated that when the ODI is large, the sagittal angle is small, the posterior extension planes of the maxilla and mandible are large, and the maxillary and mandibular sagittal ratios are small. All these measurements correlate significantly with the ODI and can therefore be used as references in diagnosing deep bite tendency. These finding agreed with Kao et al21.

Conclusion

A quadrilateral analysis of the craniofacial structures of Chennai population with normal occlusion and a balanced face were compared with anterior deep bite. The results show the following.

- In normal occlusion, the maxillary length and the mandibular length are equal.
- Anterior deep bite compared to normal, anterior facial heights are smaller.
- The sagittal angle is smaller.
- The maxillary and mandibular sagittal ratio are smaller
- The average lower facial height is smaller.
- Sagittal ratio is smaller than normal.

References

1. DiPaolo RJ .The Quadrilateral analysis, cephalometric analysis of lower face.J Practorthod 1969;3:523-30.
2. DiPaolo RJ,Markowitz JL,castldo DA.Cephalometric diagnosis using the quadrilateral analysis.J Clin orthod 1970;4:30-7
3. Chinappi AS ,DIPAOLO RJ,Langley JS.A Quadrilateral analysis of lower face skeletal pattern. Am J Orthod 1970;58:341-50.
4. Dipaolo RJ ,Philip C,Maganini AL,Hirce JD.The quadrilateral analysis :An individualized skeletal assessment .
5. Dipaolo RJ ,Philips C ,Maganini AL ,Hirce JD .The quadrilateral analysis:A Differential diagnosis for surgical orthodontics.Am J orthod 1984;86:470-82
6. Tseng YK. Quadrilateral analysis on craniofacial morphology in Taiwanese adults.chin dent J 1994;13:17-25
7. Profitt ER ,Fields HW.Contemporary orthodontics .3rd ed St.LOUIS,Mo:The CV mosphy co;200:350-352.
8. Broadbent BH.Anw x-ray technique and its application to orthodontia .Angle orthod 1931;1:45-66.
9. Downs WB. The role of cepalometrics in orthodontic case analysis and diagnosis .Am J orthod 1952;38:162-82.
10. Isaacson JR,Isaacson RJ,speidel TM ,Worms FW.Extreme variation in vertical facial growth and associated variation in skeletal and dental relations.Angle orthod 1971;41:219-229.
11. Nanda S.Pattern of vertical growth in the face .Am J orthoddentofac Orthop 1988;93:103-16.
12. Neilsen IL.vertical malocclusion :etiology ,development,diagnosis and some aspects of treatment.Angle orthod 1991;61:247-60
13. Trouten JC ,Enlow DH ,Rabine M,Phelps AE,swedlow D.Morphologic factorsin open bite and deep bite.Angle orthod 1983 jul ;53(3):192-211.

14. Beckmann SH,kuitert RB,prahl-anderson B ,Segner D ,The RP,Tuinzing DB.Alveolar and skeletal dimension associated with lower face height .Am .J Orthod dentofacial orthop.1998May ;113(5):498-506
15. Beckmann SH,kuitert RB,prahl-anderson B ,Segner D ,The RP,Tuinzing DB.Alveolar and skeletal dimension associated with overbite .Am .J Orthod dentofacial orthop.1998 Apr;113(4):443-52
16. Trouten JC ,Enlow DH ,Rabine M,Phelps AE,swedlow D.Morphologic factorsin open bite and deep bite.Angle orthod 1983 jul ;53(3):192-211.
17. Sassouni V. A classification of the skeletal facial types. Am J Orthod. 1969;55:109-123.
18. Enlow DH. Moyers RE. Hunter WS. McNamara JA. A procedure for the analysis of intrinsic facial form and growth. Am J Orthod. 1969;56:6-23.
19. McNamara JA. A method of cephalometric evaluation. Am J of Orthod 1984;86:449-469.
20. Tseng YK. Quadrilateral analysis on craniofacial morphology in Taiwanese adults. Chin Dent J 1994;13:17-25.
21. Kao CT, Chen, FM, Lin TY, Ping CH, Huang TH. The morphologic structure of the anterior openbite in adult Taiwanese. Angle Orthod 1996;3:199-206.