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The relationship between the chin and anteroposterior cephalometric indices in an Iranian Population

Rastin Sadeghian[1], Mohammad Monirifard[2] and Saeid Sadeghian[3]*

[1]Dentistry Student, Dental Students Research Center, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
[2]Dental material Research Center, Department of Orthodontics, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
[3]Dental Research Center, Department of Orthodontics, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
**Corresponding Email:Dr.rastinsadeghian@gmail.com*

ABSTRACT

The morphology of mandibular symphysis is considered as one of references for the profile evaluation. This study tried to investigate the relationship between anteroposterior profile cephalometric indicators and indicators related to the chin in lateral cephalometric radiography. This observational analytical study (historical cohort) is performed in the School of Dentistry of Isfahan university of Medical Science. The study was conducted on 201Lateral cephalometry. 67 samples in each group containing 67 class I Patient , 67 adult patients with class II and 67 adult class III patients. Indices that analyzed Are : B-B1-GN , Si to Li-PGS B-B1-GN , Id-B to Mp ,Id-B to Mp , Si to Li-PGS ,PG-ME-GO ,Basal Symphisis Width ,Alveolar Symphysis Width , Symphysial Axis , Basal Ratio , Alveolar Ratio , Basal Symphysis Angle and Alveolar Symphysis Angle . Data analyzed by using the Spearman test and ANOVA. Statistical test results showed that there is a correlation between anteroposterior and factor B-B1-GN and SitoLi-PGs. Based on the results of analysis of variance, and Tukey test of classification I and II factor POG-ME-GO, the classification I and III factor of B-B1-GN and Si to Li-PGS and the classification II and III B -B1-GN, Id-B to Mp, Id-B to Mp, Si to Li-PGS, PG-ME-GO , Alveolar Symphysis Width, Alveolar Ratio, Basal Symphysis Angle and Alveolar Symphysis Angle , there is a significant difference. There is a significant difference in chin form in various skeletal classes

Keywords: chin morphology, anteroposterior relationship, Cephalometrics

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INTRODUCTION

The relationship of chin with other facial features is important because it is necessary for the profile evaluation [1]. Mandibular symphysis morphology as a primary reference for the profile evaluation are used as well as lower incisor position in treatment planning for orthodontic and orthognathic surgery is determinant [2]. The symphysis as a predictor of the direction of mandibular rotation can be considered [3]. The shape and size of symphysis affected by function so that is biomechanical forces in different parts of the chewing cycle are synchronized experiences [4-6]. Figure symphysis indirectly affected during the growing season will be lower incisor inclination. [7] Dentofacial system of compensatory mechanisms that try to maintain harmony in the proportions face [8], Dentoalveolar compensation as a result of Bolton discrepancy during the growing season, the shape and size affect the symphysis [9]. Other factors that can affect the shape of the symphysis is the overbite of patients [10, 11], mandibular plane angle [12, 13], inheritance [14] and anteroposterior malocclusion [8, 9, 15] are the other factors.

In a study by Meng et al [15] in 2008 soft tissue of chin bone was assessed and in class I patients compared to Class II angle between chin and lip was bigger and mentolabial sulcus groove was more shallower. Noh et al [16] in 1997 divided the samples into two groups, Low Symphysis (IS) and High Symphysis (HS) based on a term called chin ratio (chin height to depth ratio) based on cephalometric the following results found:

1-skeletal features in HS groups indicate hyperdivergent patients and LS groups indicated as hypordivergent, 2. Gonial angle had strong relationship with the chin ratio 3. Chin ratio had a strong correlation with vertical height of face 4 Chin morphology was also associated with hyoid bone position.

In another study Al khateeb et al [9] in 2014 concluded that the morphology and dimension of symphysis in anterior - posterior relations concluded that in Class III malocclusions, patient had more concave jaw, and there was a bigger symphysis in class III patiemt than the other classes.

In another study by Tang et al [17] conducted in 2010, morphologically differences in skeletal Class II and Class III malocclusion symphysis area were seen. It should be noted that the prevalence of malocclusion Class I, Class II division 1, Class II division 2 and Class III in Iranian population, respectively, 41.8, 24.1, 3.4 and 7.8 percent have been reported and no significant difference was observed between gender and type of malocclusion. The prevalence of class III malocclusion in Iran's population of European descent and the prevalence of Class II malocclusion in Iranian population is comparable with European and American race however; the most severe form of Class II malocclusion in Iranian population is rare [18].

Given the importance of morphology in a beautiful chin as well as its role in planning treatment and orthognathic surgery or bone support for standard orthodontic treatment, knowing the chin morphology in relation anterior - posterior jaw is very helpful. This study aimed to evaluate and compare the morphology of the chin and lateral cephalometric radiographs using indicators in relation anterior - posterior jaw designed and performed.

MATERIALS AND METHODS

This study is historical cohort. It carried out in Cephalograms of the School of Dentistry and 3 dental clinic in Isfahan.

Inclusion Criteria

1. Cephalometric radiographs must be readable and clear.
2. Patients had no significant asymmetries and congenital anomalies.
3. Patients before cephalometric radiograph were not undergoing orthodontic treatment.
4. Class III patients with ANB angle are less than 2 degrees.
5. Class II patients with ANB angle are greater than 4 degrees.
6. Class I with ANB= 3 ± 1 patients who have dental problems and cephalometric X-ray needs to be prepared.
7. Patients older than 18 years or vertebral maturation past from CS6

Pearson's correlation coefficient with 67 samples in each group by 95% and the maximum error is approximately 0.3 object may be estimated. Cephalometric radiographs before treatment. Of 67 adult patients Class I, 67 Class II adult patients and 67 adult patients class III, which includes patients treated in several orthodontic clinic is prepared. Sampling is done with a convenient sampling. Pearson's correlation coefficient with significant level 0.05 for the correlation of the individual indexes with one anteroposterior index was related to the chin and differences with statistical significance level of 0.05 using and software were analyzed using one-way ANOVA.

All statistical analyzes were performed using SPSS 22 software. Cephalograms traced manually. Determining the study cephalometric index on Cephalograms by dental students trained and by the two orthodontists approved.

Group 1: class I patients
2<ANB<+4+
1- > Wits > 0
Group 2: class II patients
ANB>+4
0<Wits

Group 3: class III patients
ANB<2
Wits<-1

Each lateral cephalometric traced manually. Landmark and angle were drawn with a 3H pencil. Cephalometric indicators on the chin as follows (figure 1, 2 and 3):

1. Angle B-$B1_1$-Gn
2. Angle (Id_2-B-Pog)
3. Angle (B-Pog-Me)
4. Angle (Id-B with Md)
5. Angle (B-pog with Md)
6. Mentolabial sulcus depth Si to (Li-Pgs)
7. Angle (Pg-Me-Go)
8. Distance between pogonion of hard tissue (Pg) to the most prominent point of the inner surface of the symphysis.
9. Symphysis basal area width (a): the vertical distance between pogonionpoint on the mandibular symphysis to point on the inner edge of the symphysis the collision caused Pog line perpendicular to the axis of the symphysis.
10. Symphysis alveolar width alveolar (b): the vertical distance between point B on the mandibular symphysis to the point on the inner edge of the symphysis by collisions of perpendicular on symphysis axis B caused.
11. Symphysis height or symphysial axis (c): the distance between the midpoint of the cervical alveolar bone to the point of Menton
12. Basal ratio (d): c / a
13. Alveolar ratio (e): c / b
14. Basal symphysis angle (g): the angle at which filed the X2 line and make menton by mandibular plane.
15. Alveolar symphysis angle (h): it make the angle at which midpoint line in the alveolar bone cervical part to menton point with mandibular plan.

The data from the mandibular symphysis defined cephalometric parameters and those were analyzed using SPSS software.
1. Point B1: the shortest vertical distance from B to the inside of the symphysis
2. Point Id: the anterior mandibular alveolar crest the highest point on the labial (between the lower incisors)
3. Md Plan: mandibular plan

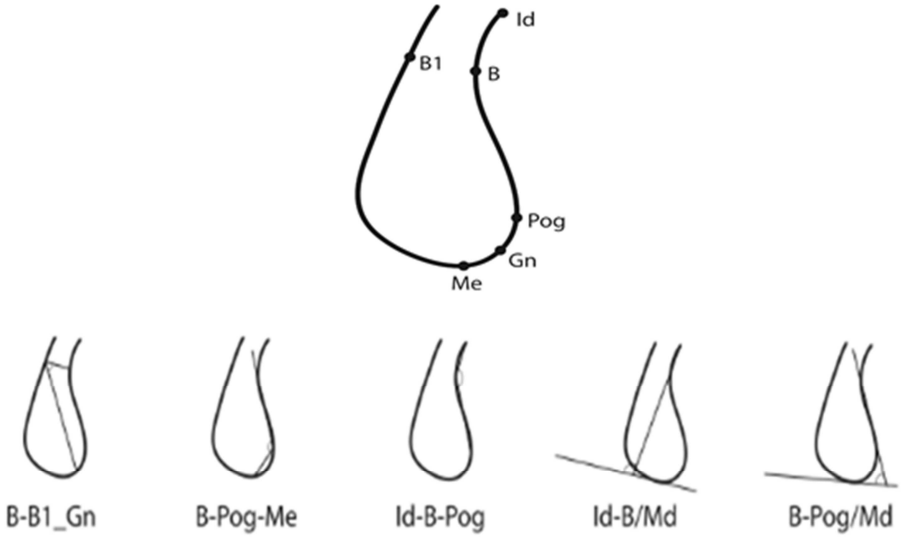

Fig. 1: cephalometric indices on chin

Fig. 2: cephalometric indices on chin

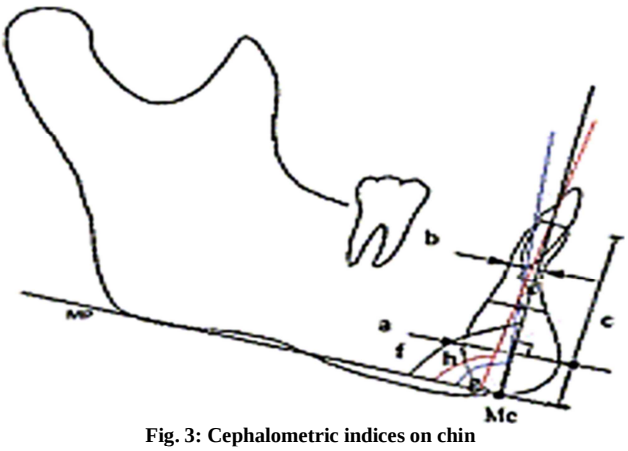

Fig. 3: Cephalometric indices on chin

Fig. 3: Different configurations of the chin

RESULTS

Based on the results obtained for the measured variable, the average for each variable in class I, II and III and significant relationship between the classification of each factor with other factors as Table 1.

Table 1: The mean (SD) in each classification variable related to dental chin

	CL I	CL II	CL III
B-B1-GN (degree)	54.65[b](7.11)	54[c](7.17)	58[b-c](8.89)
Id-B-POG (degree)	146.7(7.6)	144.08[c](7.2)	148.37[c](8.54)
B-POG-ME (degree)	128.95 (8.7)	126.08 (8.8)	128.26 (11.24)
Id-B to MD (degree)	88.45 (8.11)	86.57[c](8.24)	89.86[c](7.91)
B-POG to MD (degree)	120.72 (7.99)	120.54 (7.51)	120.57 (12.76)
Si to li –PGS (mm)	59[b](15)	64[c](14)	50[b-c](7)
PG-ME-GO (degree)	110.36[a](9.97)	115.54[a-c](13.99)	110.37[c](8.25)
Pog to inner part (mm)	138 (19)	139 (21)	139 (78)
Basal symphysis width (mm)	55 (10)	55 (12)	52 (13)
Alveolar Symphysis Width (mm)	13 (5)	11[c](5)	14[c](6)
Symphysial Axis (mm)	341 (38)	350 (44)	336 (50)
Basal Ratio (C/A)	6.33 (1.51)	6.50 (1.87)	6.85 (2)
Alveolar Ratio (C/B)	32.68 (16.83)	37[c](18.05)	29.06[c](14.13)
Basal Symphysis Angle(degree)	71.27 (6.63)	63.5[c](8.55)	70.57[c](5.63)
Alveolar Symphysis Angle(degree)	77.21 (6.53)	80.11[c](7.8)	75.61[c](6.52)

[a] *significant relationship between class I and II are based on Tukey test (p value <0.05)*
[b] *significant relationship between class I and III are based on Tukey test (p value <0.05)*
[c] *Communication between class II and III are based on Tukey test (p value <0.05)*
To investigate the relationship in each group of data, One Way ANOVA analysis was used. 4-2 are significant variables in the table.

Table 2. The relationship between all indicators based on Spearman test

	B-B1-GN	Id-B-POG	B-POG-ME	Id-B To Md	B-Pog To Md	Si To Li-Pgs	Pg-Me-Go	Pog to Innerpart	Basal symphysis width	Alveolar Symphysis Width	Symphysial Axis	Basal Ratio	Alveolar Ratio	Basal Symphysis Angle	Alveolar Symphysis Angle	ANB	Wits
B-B1-GN	1	0.314 0.000	0.305 0.000	- 0.025 0.729	- 0.233 0.001	- 0.062 0.383	- 0.060 0.379	0.044 0.534	-0.048 0.495	0.112 0.113	0.285 0.00	0.169 0.017	-.074 .296	.021 .763	-.104 .141	-.144 .042	.223 .001
Id-B-POG	.314 .000	1	.290 .000	.444 .000	-.346 .000	-.210 .003	.029 .679	.006 .937	-.154 .029	.365 .000	-.04 .574	.120 .089	-.318 .000	.060 .401	-.070 .325	-.175 .013	.129 .067
B-POG-ME	.305 .000	.290 .000	1	-.121 .088	-.269 .000	-.029 .684	-.372 .000	-.007 .925	-.412 .000	-.088 .212	.191 .007	.457 .000	.100 .159	.024 .741	.052 .466	-.056 .433	.001 .984
Id-B To Md	- .025 .729	.444 .000	-.121 .088	1	.299 .000	-.132 .062	-.124 .080	.058 .412	.060 .397	.353 .000	-.245 .000	-.186 .008	-.284 .000	-.351 .000	-.406 .000	-.161 .022	.130 .066
B-Pog To Md	- .233 .001	-.346 .000	-.269 .000	.299 .000	1	.029 .685	-.178 .011	.038 .595	.096 .173	-.059 .173	-.246 .000	-.187 .008	.045 .525	-.299 .000	-.281 .000	-.020 .775	.040 .570
Si To Li-Pgs	- .062 .383	-.210 .003	-.029 .684	-.132 .062	.029 .685	1	.120 .090	-.008 .907	.161 .022	.006 .930	.088 .216	-.085 .231	-.002 .975	-.021 .771	.059 .408	.324 .000	- .140 .047
Pg-Me-Go	- .060 .397	.029 .679	-.372 .000	-.124 .080	-.178 .011	.120 .090	1	-.017 .812	.158 .026	.110 .121	-.062 .385	-.091 .200	-.145 .040	.576 .000	.464 .000	.168 .017	- .019 .785
Pog to Inner part	.044 .534	.006 .937	-.007 .925	.058 .412	.038 .595	-.008 .907	-.017 .812	1	.182 .010	.016 .817	.207 .003	-.048 .497	.039 .586	-.101 .152	-.065 .357	.004 .956	- .044 .533
Basal symphysis width	- .048 .495	-.154 .029	-.412 .000	.060 .397	.096 .173	.161 .022	.158 .026	.182 .010	1	.190 .007	.254 .000	-.792 .000	-.077 .276	-.048 .500	-.104 .141	.111 .117	- .110 .119
Alveolar Symphysis Width	.112 .113	.365 .000	-.088 .212	.353 .000	-.059 .406	.006 .930	.110 .121	.016 .817	.190 .007	1	-.218 .002	-.215 .002	-.832 .000	.011 .877	-.088 .214	-.162 .021	.080 .258
Symphysial Axis	.285 .000	-.040 .574	.191 .007	-.245 .000	-.246 .000	.088 .216	-.062 .385	.207 .003	.254 .000	-.218 .002	1	.218 .002	.354 .000	.059 .409	.054 .449	.151 .032	.014 .839
Basal Ratio	.169 .017	.120 .089	.457 .000	-.186 .008	-.187 .008	-.085 .231	-.091 .200	-.048 .497	-.792 .000	-.215 .002	.218 .002	1	.211 .003	.169 .016	.211 .003	-.084 .238	.106 .135
Alveolar Ratio	- .074 .296	-.318 .000	.100 .159	-.284 .000	.045 .525	-.002 .975	-.145 .040	.039 .586	-.077 .276	-.832 .000	.354 .000	.211 .003	1	-.042 .553	.063 .372	.205 .004	- .042 .550
Basal Symphysis Angle	.021 .763	.060 .401	.024 .741	-.351 .000	-.299 .000	-.021 .771	.576 .000	-.101 .152	-.048 .500	.011 .877	.059 .409	.169 .016	-.042 .553	1	.817 .000	.161 .023	- .116 .102
Alveolar Symphysis Angle	- .104 .141	-.070 .325	.052 .466	-.406 .000	-.281 .000	.059 .408	.464 .000	-.065 .357	-.104 .141	-.088 .214	.054 .449	.211 .003	.063 .372	.817 .000	1	.249 .000	- .109 .125
ANB	- .144 .042	-.175 .013	-.056 .433	-.161 .022	-.020 .775	.324 .000	.168 .017	.004 .956	.111 .117	-.162 .021	.151 .032	-.084 .238	.205 .004	.161 .023	.249 .000	1	- .170 .016
Wits	.223 .001	.129 .067	.001 .984	.130 .066	.040 .570	-.140 .047	-.019 .785	-.044 .533	-.110 .119	.080 .258	.014 .839	.106 .135	-.042 .550	-.116 .102	-.109 .125	-.170 .016	1

Table 3: The relationship between class I and class II and all parameters in patients with class III

	ANB	Wits	ANB	Wits	ANB	Wits
B_B1_GN	-0.018	-0.072	.233	.222	0.153	0.247
	0.891	0580	.070	.085	0.174	0.027
Id_B_POG	-0.044	0.052	.163	.061	0.064	0.111
	0.734	0.691	.208	.639	0.573	0.328
B_POG_ME	0.235	-0.303	.112	.058	0.079	0.122
	0.067	0.018	.388	.659	0.489	0.283
Id_BtoMd	-0.171	0.192	-.025	-.035	0.130	0.099
	0.189	0.138	.851	.791	0.252	0.384
B_PogtoMd	-0.171	0.192	-.194	-.014	0.075	0.039
	0.189	0.139	.133	.915	0.508	0.703
SitoLi_Pgs	-0.279	-.0167	.234	.143	0.134	0.051
	0.029	0.179	.069	.272	0.273	0.651
Pg_Me_Go	-0.159	0.133	-.039	-.072	0.160	0.001
	0.221	0.308	.763	.579	0.155	0.995
Pog to inner part	0.009	-0.078	.051	-.097	0.031	0.042
	0.944	0.548	.697	.456	0.787	0.712
Basal symphysis width	-0.184	-0.0191	.073	-.009	0.133	0.098
	0.156	0.485	.578	.943	0.283	0.389
Alveolar Symphysis Width	-0.179	0.144	.052	-.133	0.126	0.066
	0.166	0.383	.688	.306	0.286	0.563
Symphysial Axis	0.025	-0.149	.238	.077	-0.075	0.145
	0.847	0.251	.065	.557	0.507	0.210
Basal Ratio	0.152	-0.002	-.030	-.033	-0.171	0.176
	0.243	0.989	.819	.798	0.128	0.138
Alveolar Ratio	0.04	-0.153	.126	.164	-0.132	0.038
	0.469	0.239	.335	.205	0.244	0.740
Basal Symphysis Angle	0.131	-0.085	.000	-.084	-0.042	-0.088
	0.314	0.512	.998	.520	0.712	0.439
Alveolar Symphysis Angle	0.087	-0.044	.071	-.037	-0.056	-0.064
	0.504	0.738	.589	.777	0.619	0.575
ANB	1	-0.298	1	.551	1	0.034
		0.020		.000		0.761
Wits	-0.298	1	.551	1	0.034	1
	0.020		.000		0.761	

1. There was a negative relationship between ANB and (B-B1-Gn)angle.
2. There was a negative relationship between ANB and (Id-B-Pog)angle.
3. There was a negative relationship between ANB and (Id-B with Mp)angle.
4. There was a positive relationship between ANB with mentolabial sulcus depth.
5. There was a positive relationship between ANB with (Pg-Me-Go)angle.
6. There was a negative relationship between width of the symphysis alveolar ANB (b).
7. There was a positive relationship between ANB and symphysial axis.
8. There was a positive relationship between ANB with the alveolar ratio.
9. There was a positive relationship between ANB and basal angle.
10. There was a positive relationship between ANB and alveolar angle.
11. There was a positive relationship between WITS and (B-B1-Gn)angle.
12. WITS there showed a negative relationship with mentolabial sulcus depth.

DISCUSSION

Madibular symphysis morphology is an important factor in the diagnosis and treatment planning. it is clear that an ideal treatment as well as the stability will not be achieved without considering the mandibular growth pattern. The shape and size of the mandibular symphysis orthodontic patients is an important factor in assessing and according to research conducted in such a way that, in a patient with a larger symphysis, protrusion of incisors is aesthetically more acceptable and therefore higher chances of treatment without having to pull teeth for treatment. In contrast, people with long symphysis height and a small chin, to correct the problem of space shortage will be a candidate for treatment tooth extraction [19, 20].In this study, based on test results:

Between class I and class II:

1. POG-ME-GO index correlated and it was higher in class II patients than the other classes. Due to the POG-ME-GO angle that is higher in class II and Id_B_POG and B_POG_ME that are lower in Cl II patients it can be offered

that in this study, skeletal class II patients has a more prominent pogonion and more prominent chin. Of course, these differences could be due to the other angles and therefore cannot be definitively confirmed the theory.

Between class I and class III:
1. B-B1-GN index had a strong relationship and was higher in Class III patients than Class II and Class I patients, Al-Khateeb et al [9] showed a similar results. According to higher amount of B-B1-GN angle in class III patients with less certainty can be expressed thta Class III patients had less prominent chin.

2. The index Si to Li-PGS (mentolabial sulcus depth) had a strong relationship and had higher amount in class I than class III but it was highest in class II patients. The reason for this can be attributed to Dental compensation in skeletal Class II patients because of lower incisor protrusion in skeletal Class II Li placed more forward and then of course it show a higher amount in mentolabialsalcus depth.

Between class II and class III:
1. B-B1-GN relationship was strong and the highest amount of angle showed in class III patients.

2. Id-B to MD, which represents inclination of the alveolar part of mandibular symphysis also showed a strong significant relationship and its value in the class III more than class I and class II, which showed concavity of middle part of the mandibular symphysis is higher in class III patients but in the study of Yamada et al. [7] in 2007, was in contradiction with our results. While in the Al-Khateeb et al [9] which assessed the same angle and similar results were obtained.

3. Alveolar symphysis angle: significant relationship was strong and had the highest amount in class II patients. it was lowest in class III patients. Higher amount of this angle in class II patients can be attributed lower incisors compensation which results the protrusion of the incisors. Another angle on this study was to investigate the symphysis basal angle (mentioned bellow as number 4), which on the contrary results and in class III patients was higher thn class II. Suggested reason for this is that because the basal symphysis angle will not be affected by the alveolar part of symphysis. So the inclination and compensation of low incisors will be unaffected. Therefore, we can say that based on the results of the present study basal slope of the symphysis to forward was higher in the class III patients than Class II patients.

4. Basal symphysis angle correlated and its value in Class III was more than Class II patients, while the highest value was in Class I patients and represents mandibular incisor inclination toward manndibular angle.

5. Alveolar symphysis width had a significant correlation and it was highest in class III patients and lowest in class II patients.

6. Si to Li-PGS (mentolabial sulcus depth) had a strong relationship and had higher amount in class I than class III. But it was highest in class II patients. The reason for this can be attributed to Dental compensation in skeletal Class II patients. Because of lower incisor protrusion in skeletal Class II Li placed more forward and then of course it shows a higher amount in mentolabialsalcus depth.

7. Alveolar ratio had significant relationship and it was highest in the class II and much higher value than class III patients which had the lowest value.

According to Spearman's test results:
Between Class I:
1. There was positive relationship between ANB and mentolabial sulcus depth
2. There was negative relationship between wits and B-pog-Me.

Between class 2:
1. There was no significant relationship between anteroposterior indexes and indexes of chin.

Between Class 3:
1. There was positive relationship between wits and B-B1-Gn.

The relationship between ANB and Wits anteroposterior and indicators did not measured on the chin in another study so it was not possible to compare its results with any other study.

CONCLUSION

1. Based on the results there is a significant relationship between the configuration of chin and different Dental Classes;
2. In Class I patients there was positive relationship between ANB and mentolabial sulcus depth which show a higher amount in Class II patients;
3.There was negative relationship between wits and B-pog-Me in Class I patients;
4. In class II patients there was no significant relationship between anteroposterior indexes and indexes of chin;
5. In class III patients there was positive relationship between wits and B-B1-Gn;
6. In this study, skeletal Class II patients had a more prominent chin;
7. In this study, the slope of the alveolar part of symphysis in the class II was higher than others;
8. In the present study, the slope of basal part of symphysis in the class III was higher than others.
This relationship is reported in different forms in different studies.

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