DE GRUYTER
OPEN

10.1515/bjdm-2015-0048

BALKAN JOURNAL OF DENTAL MEDICINE

BaSS

ISSN 2335-0245

Study of Craniofacial Relations and Facial Types in Greek Population with Normal Occlusion

SUMMARY

The purpose of this study was to determine the range of certain skeletal structures and investigate their relationship and facial types in Greeks with normal occlusion. 123 lateral cephalometric radiographs obtained from 65 males and 58 females (mean age: 24 and 23 years respectively) with normal occlusion were studied at the Dental School of Aristotle University of Thessaloniki. Angles SNA, SNB, NL-NSL, ML-NSL, NSBa and ML-NL were measured and analysed.

Females presented significantly greater posterior inclination of the mandible (ML-NSL) and larger cranial deflection (NSBa) than males. Correspondence Analysis determined the relationships between the six variables and resulted in grouping the sample into 3 different facial types: (1) Type A (Prognathic), characterised by high SNA and SNB values, anterior-upper inclination of the maxilla, anterior inclination of the mandible and small cranial deflection; (2) Type B (Orthognathic), with intermediate values, which correspond to medium type of the normal range; and (3) Type C (Retrognathic), characterised by low SNA and SNB values, posterior inclination of both, the maxilla and the mandible, and high cranial deflection. These relationships were similar for both males and females.

Keywords: Cephalometric Analysis; Normal Occlusion; Facial Type; Greeks

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ORIGINAL PAPER (OP)
Balk J Dent Med, 2015; 19:132-140

Introduction

Dental occlusion and the craniofacial system were characterised as normal according to Angle's classification. However, with the use of lateral cephalometric radiography, it became possible to investigate skeletal relations as well, so that a great variety of structures and a wide range of morphological combinations have been discovered in the various cases presenting clinically normal dental occlusion[1-3].

There are more than 100 different methods of cephalometric analysis, the most interesting being methods of: Bjork[4], Downs[5], Coben[6], Sassouni[7], Steiner[8], Tweed[9], Ricketts[10,11], Hasund[3], Salzman[12], Enlow[13], Langlade[14], McNamara[15], Moyers[16] and Miethke[17]. Many authors have studied the range of normal values and interaction of craniofacial structures in cephalometric radiographs, using various reference points[6,10,18-21].

A correlation was discovered between rotation and shape of the upper and lower jaws[22], as well as between sagittal, vertical and transverse relationships of jaw bases in normal occlusion[23]. A variety of sagittal skeletal relations between the jaws was recorded in individuals with normal occlusion[24], as well as interaction and compensation patterns emerging from the position of the jaws, the overjet and the incisor inclination[25]. Other researchers found out that there are differences regarding the size and morphology of the craniofacial complex, depending on gender and race[26-32].

Researches in Greek population with normal occlusion and a harmonious face have shown gender-dependent differences in morphological pattern of facial skeleton features[33-37]. In the cephalometric analysis of Bergen-Clinik, Hasund recorded harmonious combinations between sagittal positions of the jaws and their inclination in relation to cranial deflection in a table based on Scandinavian population data[3].

Because the morphological pattern of the craniofacial complex varies in different ethnic groups, as well as between genders, it was considered necessary to study skeletal structures of Greeks so as to determine range of values and discover corresponding harmonious combinations and facial types of Greek population that will establish patterns to facilitate individualised cephalometric analysis.

The purpose of this investigation was:

1. To study skeletal structures that determine the position and inclination of the jaws and cranial deflection, and
2. To determine the range of variation, as well as harmonious combinations of structures, corresponding to various normal occlusion facial types in Greek population.

Materials and Methods

The material of this retrospective study comprised 123 lateral cephalometric radiographs of an equal number of adult Greeks obtained from the archive of the Orthodontic Department laboratory of the Aristotle University of Thessaloniki; these were radiographs of 65 men and 58 women, whose mean age was 23.5 years. The selected samples presented full dentitions with normal occlusion and a harmonious face, and they had never undergone orthodontic treatment.

On the tracing of each lateral cephalometric radiograph, 6 angles were measured, which concern the basic structures of the craniofacial complex (Fig. 1). These measurements determined sagittal position of the maxilla (SNA) and sagittal position of the mandible (SNB) in relation to the anterior cranial base, as well as inclination of the maxilla (NL - NSL) and the mandible (ML - NSL) in relation to the anterior cranial base. Maxillo-mandibular angle (ML-NL) and cranial deflection (SNBa) were also measured.

Statistical analysis of the results was performed separately for men and women and mean values, standard deviations and range of values were determined for each variable. Then quadrants were determined and each variable was divided into 3 sections, depending on the magnitude of the values recorded. The first and third quadrant contained 25% of the population with extreme variable values each, while the middle section, characterised as the intra-quadrant range, contained 50% of the population with intermediate values for the same variable. Men's and women's data were then processed using the Student's t-test[38]. The study of the interaction and correlation of variables following the division of each variable into 3 classes was done with Factorial Correspondence Analysis[39]. Men and women were studied separately to ensure full investigation of such interactions.

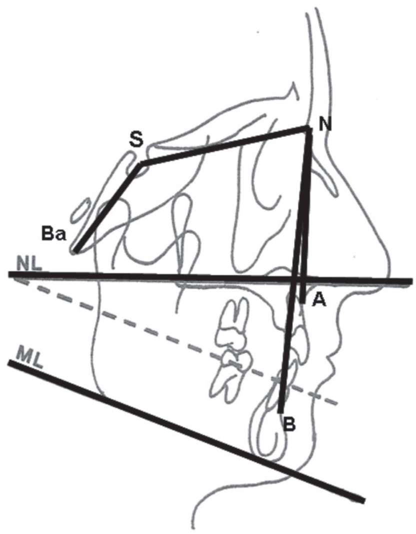

Figure 1: Variables: Angles SNA, SNB, NL-NSL, ML-NSL, ML-NL, NSBa.

After 2 weeks, 20 randomly selected radiographs were traced and measured by the same researchers to determine the experimental error of the method, which was checked using a t-test and a significance level of α=0.05. No statistically significant differences were found for the 6 variables (Tab. 1).

Table 1. Error of the method

Variables		p
SNA	0.678	>0.05
SNB	0.537	>0.05
NL – NSL	0.690	>0.05
ML - NSL	0.712	>0.05
ML - NL	0.742	>0.05
NSBa	0.643	>0.005

Results

Statistical Analysis

The study resulted in the findings recorded in tables 2-7. These tables present the minimum, maximum and mean values, standard deviation and determination of the quadrants that divide each variable value into 3 groups, depending on the magnitude of the measurement value, separately for men and women. Group 1 includes the low values, group 2 the medium values and group 3 the high values for each variable, in accordance with the determination of the quadrants.

The findings of the sagittal position of the maxilla (< SNA) and the mandible (<SNB) are presented in tables 2 and 3, while the inclination of the maxilla (<NL-NSL) and the mandible (<ML-NSL) in relation to the anterior cranial base, the maxillo-mandibular angle (ML-NL) as well as cranial deflection (<NSBa) in tables 4-7, respectively.

Table 2. SNA angle - Sagittal position of the maxilla (a), and ranking of the SNA variable into 3 groups depending on the quadrant classification (b)

SNA(°)	♂n=65	♀n: 58
Mean value:	82.5	82.5
Standard deviation:	4.2	3.6
Minimum value:	69	73
Maximum value:	93	91
Lower quartile:	80	80
Upper quadrant:	85	85
Interquartile range:	5	5
p	NS	

(°)	♂	♀
SNA1	69-79	73-79
SNA2	80-85	80-85
SNA3	86-93	86-91

Table 3. SNB angle - Sagittal position of the mandible (a), and ranking of the SNB variable into 3 groups depending on the quadrant classification (b)

SNB (°)	♂n=65	♀n: 58
Mean value:	80.5	79.35
Standard deviation:	3.6	3.5
Minimum value:	70	71
Maximum value:	90	88
Lower quartile:	78	77
Upper quadrant:	83	82
Interquartile range :	5	5
p	NS	

(°)	♀	♂
SNB1	71-76	70-77
SNB2	77-82	78-83
SNB3	83-88	84-90

Table 4. NL-NSL angle - Inclination of the maxilla (a), and ranking of the NL-NSL variable into 3 groups depending on the quadrant classification (b)

NL-NSL (°)	♂n=65	♀n: 58
Mean value:	8.2	9.1
Standard deviation:	3.5	2.7
Minimum value:	1	2
Maximum value:	21	15
Lower quartile:	6	7.5
Upper quadrant:	11	11
Interquartile range :	5	3.5
p	NS	

(°)	♂	♀
NL-NSL 1	1-4	2-6
NL-NSL 2	5-10	7-11
NL-NSL 3	11-14	12-15

Table 5. ML-NSL angle - Inclination of the mandible (a), and ranking of the ML-NSL variable into 3 groups depending on the quadrant classification (b)

ML-NSL(°)	♂n=65	♀n: 58
Mean value:	27	29
Standard deviation:	5.4	5.5
Minimum value:	16	18
Maximum value:	38	45
Lower quartile:	24	26
Upper quadrant:	30	33
Interquartile range:	6	7
p	< 0.05	

(°)	♂	♀
ML-NSL 1	16-22	18-24
ML-NSL 2	23-30	25-32
ML-NSL 3	31-38	33-45

Table 6. ML-NL angle - Divergence of the jaws (a), and ranking of the ML-NL variable into 3 groups depending on the quadrant classification (b)

ML-NL(°)	♂n=65	♀n: 58
Mean value:	19	20
Standard deviation:	5.6	5
Minimum value:	2	8.5
Maximum value:	29	34
Lower quartile:	15	17
Upper quadrant:	24	22
Interquartile range:	9	5
p	NS	

(°)	♂	♀
ML-NL 1	2-14	8.5-16
ML-NL 2	15-24	17-22
ML-NL 3	25-29	23-34

Table 7. NSBa angle - Cranial deflection (a), and ranking of the NSBa variable into 3 groups depending on the quadrant classification (b)

	♂n=65	♀n: 58
Mean value:	129	132.5
Standard deviation:	4.3	4.2
Minimum value:	120	122
Maximum value:	138	143
Lower quartile:	126	130
Upper quadrant:	132	135
Interquartile range:	6	5
p	< 0.001	

(°)	♂	♀
$NSBa_1$	120-125	122-129
$NSBa_2$	126-132	130-135
$NSBa_3$	133-138	136-143

Correspondence Analysis

Factorial Correspondence Analysis was applied to the 6 variables divided into 3 classes, depending on the magnitude of values measured, separately for men and women.

(1) Correspondence Analysis in men. The correspondence analysis applied in the male population (Fig. 2; Tab. 8) confirmed that on the first factorial axis, individuals are ranked from left to right: those with low SNA and SNB values appear first, those with middle

values of SNA and SNB next, followed by individuals with high SNA and SNB values. The rest of the variables appear on the horizontal axis, from left to right, with high values of variables NL-NSL, ML-NSL, ML-NL and NSBa appearing first, middle values in the centre and low variable values on the far right.

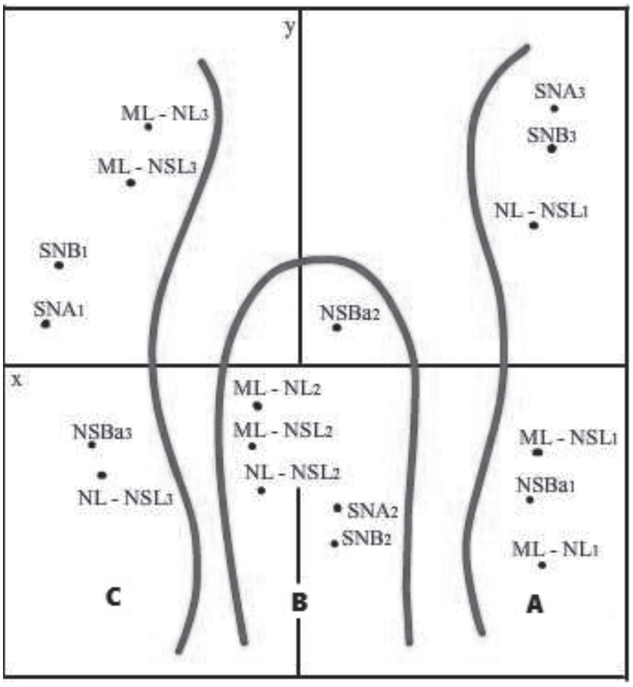

Figure 2. Correspondence Analysis in males

Table 8. Correspondence Analysis in men

	Facial Type A (Retrognathic)	Facial Type B (Orthognathic)	Facial Type C (Prognathic)
	Range of Values	Range of Values	Range of Values
SNA	69° - 79°	80° - 85°	86° - 93°
SNB	70° - 77°	82° - 83°	83° - 90°
NL-NSL	11° - 14°	5 ° - 10°	1° - 4°
ML-NSL	31° - 38°	23° - 30°	16° - 22°
ML-NL	25° - 29°	15° - 24°	2° - 14°
NSBa	133° - 138°	126° - 132°	120° - 125°

On the first factorial axis the normal men sample was divided into 3 distinct groups: on the left were cases characterised by low variable values that determine jaw protrusion (SNA_1 and SNB_1) and high values for variables that characterise the inclination of the jaws in relation to the cranial base ($NL\text{-}NSL_3$, $ML\text{-}NSL_3$), the divergence of the jaws ($ML\text{-}NL_3$), and cranial deflection ($NSBa_3$). In the centre there were all cases with medium values for all variables. Finally, on the right side, there were cases with high variable values, which concern jaw protrusion (SNA_3 and SNB_3) and low values for the rest of the variables ($NL\text{-}NSL_1$, $ML\text{-}NSL_1$, $ML\text{-}NL_1$ and $NSBa_1$).

On the second factorial axis, cases were ranked from bottom to top, so as to allow for the creation of secondary sub-groups in both the prognathic and orthognathic (medium) facial types, which explains the variability within the normal value range.

The correspondence analysis for men resulted in dividing the normal sample into 3 facial types, namely: the prognathic (Type A), the orthognathic - medium (Type B) and the retrognathic (Type C).

(2) Correspondence Analysis in women

After the correspondence analysis was applied in 6 variables characterising the female population (Fig. 3; Tab. 9), 3 distinct groups emerged at the first factorial level, created by the first and second factorial axes. On the left there were individuals characterised by high values of the variable determining the degree of jaw protrusion (SNA_3 and SNB_3) and low values of the variables that characterise jaw inclination in relation to the anterior cranial basis ($NL\text{-}NSL_1$, $ML\text{-}NSL_1$), the divergence of the jaws ($ML\text{-}NL_1$) and cranial deflection ($NSBa_1$).

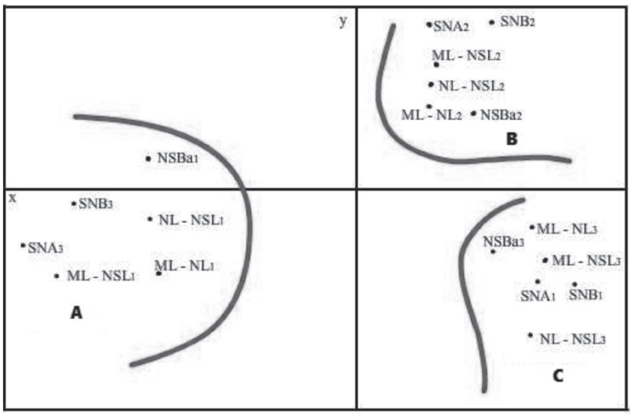

Figure 3. Correspondence Analysis in females

Table 9. Correspondence Analysis in women

	Facial Type A (Retrognathic)	Facial Type B (Orthognathic)	Facial Type C (Prognathic)
	Range of Values	Range of Values	Range of Values
SNA	73° - 79°	80° - 85°	86° - 91°
SNB	71° - 76°	77° - 81°	82° - 88°
NL-NSL	12° - 15°	7 ° - 11°	2° - 6°
ML-NSL	33° - 45°	25° - 32°	18° - 24°
ML-NL	23° - 34°	17° - 22°	8,5° - 16°
NSBa	136° - 143°	130° - 135°	122° - 129°

On the upper right section there was the second group, i.e. women with intermediate values for all variables. Finally, on the right and below the second factorial axis, were cases of the third group with low values of variables concerning the degree of protrusion of the jaws (SNA_1 and SNB_1) and high values of the other variables ($NL\text{-}NSL_3$, $ML\text{-}NSL_3$, $ML\text{-}NL_3$ and $NSBa_3$).

The correspondence analysis resulted in dividing the normal adult sample into 3 facial types, namely:

1. Type A (Prognathic), characterised by high SNA and SNB values, anterior-upper inclination of the maxilla, anterior inclination of the mandible and small cranial deflection;
2. Type B (Orthognathic), with intermediate values, which correspond to the orthoganathic/medium type of the normal range; and
3. Type C (Retrognathic), characterised by low SNA and SNB values, lower posterior inclination of the maxilla, posterior inclination of the mandible and high cranial deflection.

Discussion

The SNA angle has been studied by numerous researchers since this angle is the basic measurement of most cephalometric analyses. Some of the findings for members of various ethnic origin groups are presented in table 10. The value of the SNA angle in various populations ranges from 79.39° to 83.9°. The lowest mean value was found among northern Germans[31] and the highest among Americans[15].

Table 10. SNA angle of varying ethnic origin groups

SNA angle						
Nationality	n	Age	Gender	Mean	SD	Authors
Americans	33	15	males	8°	3.2°	Riolo et al. (1974)
	19	15	females	81.8°	3.5°	Riolo et al. (1974)
	38	adults	males	83.9°	3.2°	McNamara (1984)
	73	adults	females	82°	4°	McNamara (1984)
Scandinavians	93	adults	males	82.1°		Hasund (1981)
Northern Americans	84	adults		79.39°	4.97°	Slavicek and Schadlbauer (1982)
Austrians	649	adults		81.79°	3.99°	Slavicek and Schadlbauer (1982)
Greeks						
	31	adults	males	81.5°	2.53°	Xeniotou -Voutsina (1972)
	49	adults	females	81.63°	3.73°	Xeniotou -Voutsina (1972)
	147	adults	males	80.99°	3.89°	Kavvadia-Tsatala (1985)
	129	adults	females	80.75°	3.93°	Kavvadia-Tsatala (1985)

The value of the SNB angle presents a wider range of values in men, the mean value being 80.5°±3.6°, as well as in women, the mean value being $79.3°±3.5^0$. The average value for Americans is found to be 77.6° for men and 78.9° for women[40], while among Scandinavian men the mean value of this angle is 80°[3]. The values found in this paper are similar to the findings for the Greek population[33], as well as to the values for Scandinavians, but they are quite higher than the corresponding values for Americans.

Inclination of the maxilla in relation to the anterior cranial base, which is expressed with the NL-NSL angle, has a higher mean value in women and smaller intrerquartile range, without statistically significant difference from men. According to Riolo et al[40], the mean value for this inclination was found to be 6.9± 3.4 in men and 7.8±2.4 in women. A difference is noted between the 2 genders similar to that found in the Greek population. Scandinavian men[3] present mean values for the NL-NSL angle similar to those found among Greek men.

Lower jaw inclination in relation to the anterior cranial base (ML-NSL angle), which indirectly controls anterior and posterior facial heights, presented significant differences between genders ($p<0.05$), with angle values being higher among women. Minimum and maximum values were also higher among women; this means that mandibular inclination is more posterior in women than in men or that women present more mandibular retrusion than men. It seems that value limits among Greeks were lower than the corresponding ones among Americans, who present a mean value of 33.2°±5.2° for men and $32.4^0 \pm 5.8^0$ for women[40]. The findings of a similar study performed in another group of the Greek population[33] presented no differences in regard to this angle.

Statistical processing of the value of cranial deflection showed significant difference in mean values between the two genders ($p<0.05$), the value being higher among women; in other words, the direction of growth of the posterior cranial base and, indirectly, of the head, is more posterior among women than among men. Values for this angle in various populations are presented in table 11. Jaw divergence follows the same pattern of difference between genders; it seems that women present hyper-divergence, although not significant, when compared to men. A similar difference between genders has been recorded among Americans[40]. Correspondence analysis was performed separately for men and women, because the limits and mean values of the variables have been found to be different in 2 genders.

Table 11. NSBa angle values in various populations

NSBa angle (adults)				
Nationality	Gender	Mean	SD	Authors
Americans	males	129°	5.4°	Riolo et al. (1974)
	females	130.3°	4°	Riolo et al. (1974)
Scandinavians	males	130°		Hasund (1981)
Greeks	males	130.5°	5.4°	Xeniotou -Voutsina (1972)
	females	133.2°	4.96°	Xeniotou -Voutsina (1972)
Greeks	males	129°	4.3°	Author findings
	females	132.5°	4.2°	

Factorial analysis confirmed the relations and interactions of variables in harmonious cases with normal occlusion, which led to the division of the normal sample of adult Greeks into 3 groups, corresponding to 3 facial types. It was confirmed that the position of the maxilla is related to its inclination and cranial deflection for a large number of values and harmonious combinations for normal faces. Similar relations and interdependences of the size and position of the maxilla in relation to the rest of the craniofacial complex have also been confirmed by other studies[4,8,11,15,21,41].

In the lower facial complex, the larger the SNB angle has been observed, i.e. the more prognathic the mandible, the smaller its inclination angle, i.e. the more anterior its inclination and the smaller the cranial deflection, so that a harmonious combination of these 3 variables is maintained. These relationships are the same for both genders. The relationship between the position of the mandible, the type of facial growth and cranial deflection is also included in the work of other researchers[3,14,28,42]. These relationships are similar to those studied by Hasund, on the basis of which he constructed the Table of Harmonious Combinations for Scandinavians[3]. He considered these relationships as part of the broader context of craniofacial relations, in accordance with Solow's theory[1]; these are also valid for all races. Differences noted between various ethnic groups and populations are differences in values but not in relationships.

The Table of Harmonious Combinations of these variables determined by Hasund[3], based on measurements among the Scandinavian population, confirms that prognathic, orthognathic and retrognathic types among Scandinavians are characterised by different limits to the values of variables and different harmonious combinations as compared to those among Greeks. This is, of course, due to differences in the values of variables between genders and between ethnic groups.

Conclusions

Females presented larger cranial deflection and significantly posterior inclination of the mandible than males.

There is a relationship between the position and inclination of the maxilla and the mandible and the value of cranial deflection. The anterior position of the maxilla is accompanied by anterior-upward inclination, small cranial deflection, small divergence of the jaws and anterior position and inclination of the mandible, while the posterior position of the maxilla is accompanied by posterior-downward inclination, larger cranial deflection, larger divergence of the jaws and posterior position and inclination of the mandible, in a harmonious combination. These relationships are similar for both males and females.

The normal adult sample is divided into 3 facial types:

1. Type A (prognathic), characterised by high SNA and SNB values, anterior-upper inclination of the maxilla, anterior inclination of the mandible, small divergence of the jaws and small cranial deflection;

2. Type B (orthognathic), with intermediate values, which correspond to the medium type of the normal range;

3. Type C (retrognathic) characterised by low SNA and SNB values, lower posterior inclination of the maxilla, posterior inclination of the mandible, hyper-divergence of the jaws, and high cranial deflection.

Harmonious combinations present different range of values in the genders.

References

3. *Solow B*. The pattern of Craniofacial Associations. A morphological and methodological correlation and factor analysis study on young male adults. *Acta Odont Scand,* 1966; 24(Suppl. 46).
4. *Solow B*. The Dentoalveolar Compensatory Mechanism: Background and Clinical implications. *Br J Orthod*, 1980; 7:145-161.
5. *Hasund A*. Klinische Kephalometrie fur die Bergen~Technik Universitat Bergen/Norwegen 1973, 1981; Deutsh. Aufl.
6. *Bjork A*. The Face in Profile. An anthropological X-Ray investigation on Swedish children and conscripts. *Svensktandlakare-Tidskriff*, 1947; 40:1-180.
7. *Downs WB*. The Role of Cephalometrics in Orthodontic Case Analysis and Diagnosis. *Am J Orthod*, 1952; 38(3):162-182.
8. *Coben SE*. The Investigation of Facial Skeletal Variants. A serial cephalometric roentgenographic analysis of craniofacial form and growths. *Am J Orthod*, 1955; 41(6):407-434.
9. *Sassouni V*. Roentgenographic Cephalometric Analysis of Cephalo-facial Dental Relationships. *Am J Orthod*, 1955; 41:735-764.
10. *Steiner C*. Cephalometrics in Clinical Practice. *Angle Orthod*, 1959; 29:8-29.
11. *Tweed CH*. The Diagnostic Facial Triangle in the Control of Treatment Objectives. *Am J Orthod*, 1960; 5:651-667.
12. *Ricketts RM*. Present Problems in Applied Cephalometrics. Roentgenographic Cephalometrics. Philadelphia, Toronto: J B Lippincott Co, 1961; pp 128-132.
13. *Ricketts RM*. Analysis. The Interim. *Angle Orthod*, 1970; 40:129-137.
14. *Salzmann JA*. Orthodontics in Daily Practice. M B Lippincott Co, 1974; pp 183-196.
15. *Enlow H*. Handbook of Facial Growth. Philadephia, London, Toronto: W B Saunders Co, 1975; pp 251-289.
16. *Langlade M*. Cephalometrie Orthodontique. Paris: Maloine S A, 1978; pp 17-30.
17. *McNamara J Jr*. A method of Cephalometric Evaluation. *Am J Orthod*, 1984; 86:449-469.
18. *Moyers RE, Bookstein FL, Hunter WS*. Analysis of the Craniofacial Skeleton: Cephalometrics. In: Moyers RE (ed). Handbook of Orthodontics. Chicago: Yearbook Medical Publishers, 1988; pp 247-309.
19. *Miethke R*. Possibilities and Limitations of Various Cephalometric Variables and Analyses. In: *Athanasiou AE* (ed). Orthodontic Cephalometry. London: Mosby-Wolfe, 1995; pp 63-103.
20. *Maj G*. Un nouveau système d' analyse cephalometrique. Bases théoriques. *Ortho Franc*, 1957; 28:327-334.
21. *Luzi C*. Un nouveau système d' analyse cephalometrique. Methodologie et application clinique. *Ortho Franc*, 1957; 28:335-344.
22. *Ricketts RM, Roth RH, Chaconas SJ, SchuIhof RJ, Engel GA*. Orthodontic Diagnosis and Planning, Volume I. Rocky Mountain Data Systems, 1982; pp 13-169.
23. Rana *T, Khanna R, Tikku T, Sachan K*. Relationship of Maxilla to Cranial Base in Different Facial Types - a Cephalometric Evaluation. *J Oral Biol Craniofac Res*, 2012; 2(1):30-35.
24. *Bjork A, Skielier V*. Facial Development and Tooth Eruption. An implant study at the age of puberty. *Am J Orthod*, 1972; 62:339-383.
25. *Solow B*. The Dentoalveolar Compensatory Mechanism: Background and Clinical Implications. *Br J Orthod*, 1980; 7:145-161.
26. *Slavicek R, Schadlbauer E, Schrange J, Mack H*. Les rapports squelettiques et la compensation dento-alvéolaire. *Revue d' O D F*, 1983; 17:493-516.
27. *Lundstrom A, William J*. Dento-alveolar Compensation for Anteroposterior Variations between the Upper and Lower Apical Bases. *Eur J Orthod*, 1984; 6:116-122.
28. *Crutcher F*. Harmonious Anthropometric Relationship. *Angle Ortho*, 1961; 31:18-34.
29. *Miura FM, Inoue N, Suzuki K*. Cephalometric Standards for the Japanese according to the Steiner analysis. *Am J Orthod*, 1965; 51:288-295.
30. *Lundström A, Woodside DG*. Individual Variation in Growth Directions Expressed at the Chin and the Midface. *Eur J Orthod*, 1980; 2:65-79.
31. *Bishara SE, Jamison JE, Peterson LC, Dekock WH*. Longitudinal Changes in Standing Height and Mandibular Parameters between the Ages of 8 and 17 Years. *Am J Orthod*, 1981; 80:115-135.
32. *Enlow DH, Pfister C, Richardon E, Kuroda T*. An Analysis of Black and Caucasian Craniofacial Patterns. *Angle Orthod*, 1982; 52:279-287.
33. *Slavicek R, Schadlbauer E*. Etude et comparaison de valeurs céphalométriques régionales en Autriche et en Allemagne. *Revue d' O D F*, 1982; 16:417-471
34. *Ahsan A, Yamaki M, Hossain Z, Saito I*. Craniofacial Cephalometric Analysis of Bangladeshi and Japanese Adults with Normal Occlusion and Balanced Faces: A comparative study. *J Orthod Sci*, 2013; 2(1):7-15.
35. *Xeniotou-Voutsina A*. Determination of the Values of Skeletal and Dental Relations using Cephalometric

Radiographs in adults with Harmonious Occlusion. *Odontiatriki [Dentistry]*, 1972; 6:407-419.
36. *Kolokythas G*. Determination of craniofacial morphology values in Greeks using the method of cephalometric radiography. Habilitation Dissertation. Thessaloniki, 1981.
37. *Kavvadia-Tsatala S*. Cephalometric Study of the morphology, size and position of the mandible in relation to anterior facial heights. PhD Thesis. Aristotle University of Thessaloniki, 1985.
38. *Ioannidou-Marathiotou I*. Study of Dental and Alveolar Compensation in the Facial Morphology of Adult Greeks. PhD Thesis. Aristotle University of Thessaloniki, 1986.
39. *Topouzelis N*. Investigation of Facial Soft Tissue Morphology among Greeks with Normal occlusion and a Harmonious Face Using the Method of the Lateral Cephalometric Radiography. PhD Thesis. Aristotle University of Thessaloniki, 1986.
40. *Papadimitriou I*. Statistics, Issue 1. Descriptional Statistics. Paratiritis Publications, Thessaloniki, 1986. (in Greek)
41. *Blasius J, Greenacre MJ*. Multiple Correspondence Analysis and Related Methods. London: Chapman and Hall, 2006.
42. *Riolo ML, Moyers RE, McNamara JA, Hunter WS*. An Atlas of Craniofacial Growth: Cephalometric Standards from the University School Growth Study, The University of Michigan. Ann Arbor, Center of Human Growth and Development, The University of Michigan, 1974; pp. 201-207.
43. Vieira *FP, Pinzan A, Janson G, Fernandes TMF, Sathler RC, Henriques RP*. Facial Height in Japanese-Brazilian Descendants with Normal Occlusion. Dental Press J Orthod, 2014; 19(5):54-66.

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