ORIGINAL ARTICLE

Eastern Journal of Medicine
East J Med 24(1): 1-7, 2019
DOI: 10.5505/ejm.2019.40570

An Assessment of Gender Difference in Visual Cephalometric Analysis Applied to Class I Individuals: A Preliminary Study

Zekiye Karaca Bozdag[1*], Ayla Kurkcuoglu[2], Ayca Ustdal Guney[3], Yener Cam[3], Ozkan Oguz[4]

[1]*Department of Anatomy, Faculty of Medicine, Istanbul Yeni Yuzyil University, Istanbul, Turkey*
[2]*Department of Anatomy, Faculty of Medicine, Baskent University, Ankara, Turkey*
[3]*Department of Ortodonty, Faculty of Dentistry, Cukurova University, Adana, Turkey*
[4]*Department of Anatomy, Faculty of Medicine, Cukurova University, Adana, Turkey*

ABSTRACT

Cephalometric analyzes play an important role in determining the individual's skeletal and dental structure, soft tissue and their relationship to each other. Visual cephalometric analyzes are primarily based on determining the fitness between mid-face and maxilla, then positioning the mandible relative to the midface. Thus, as in the other cephalometric analyzes, changes related to the treatment and development of the current state of the individual are determined. In the study we aimed to reveal sex-related changes of four different angles and compare them with the norm.

This study was performed on right lateral cephalometric views of 80 healthy (40 women, 40 men) Turkish individuals in Anatolia aged 21-71, with Class I skeletal (ANB=2.19±1.43). In all images, angles formed by long axis of the upper incisor and palatal plan (U1/PP); the long axis of the lower incisor and mandibular plan (A1/MP); the long axes of the lower and incisor (U1/A1); the palatal plan and mandibular plan (PP/MP) were analyzed.

The PP/MP value of women was found to be significantly higher than men's ($p<0.01$), while no significant difference was found between the U1/PP, A1/MP and U1/A1. Statistically significant negative correlations were found between correlations of all angular measurements in both genders ($p<0.05$).

As a result, gender should also be considered as another factor beside the knowledge of angles of U1/PP, A1/MP, U1/A1 and PP/MP in orthodontic diagnosis and treatment planning. Our work continues by increasing the number of data.

Key Words: Visual Cephalometric Analysis, Maxillomandibular relationship, Class I

Introduction

Cephalometric analyzes play an important role in determining the individual's skeletal and dental structure, soft tissue and their relationship to each other. Visual cephalometric analysis was introduced by Fastlicht in 2000 and it has been argued that errors can be reduced by using cranial reference planes (1). Visual cephalometric analysis is based primarily on the positioning of the mandibular according to the mid-face to determine the mid-face maxilla fit. It also introduces dental camouflage for maxillomandibular contact. Thus, as in other cephalometric analyzes, it is possible to determine the current state of the individual, and to determine changes related to treatment and development (2). The cephalometric analyzes are mainly focused on skeletal relations and are defined by a number of variables. When assessing facial incompatibilities, the values of individuals with a good occlusion are compared with the cephalometric data obtained from the patient. Cephalometric analyzes facilitate the planning of treatment while using individual assessments, as well as facilitate communication between colleagues and teaching treatment methods (3). Cephalometry is the standard lateral graft used to assess bone and soft tissue in the head and neck region (4). Recently, cephalometry as a diagnostic tool has become an indispensable assistant to disciplines such as orthodontics, jaw surgery and prosthodontics (5). Various analyzes have been developed by different researchers in order to be able to define qualitative and quantitative aspects of facial profiles with the introduction of cephalometric films (6). Cephalometry is also an important tool used for face identification purposes (7). In the events like death, loss and in the

***Corresponding Author:** Zekiye Karaca Bozdag, PhD Student, Istanbul Yeni Yuzyil University, Faculty of Medicine Department of Anatomy, 34010 Zeytinburnu, Istanbul Turkey
E-mail: zekiye.karaca@yeniyuzyil.edu.tr, Fax: 0(212) 481 40 58, Phone: 0(507) 118 01 80
Received: 09.01.2018, **Accepted:** 29.11.2018

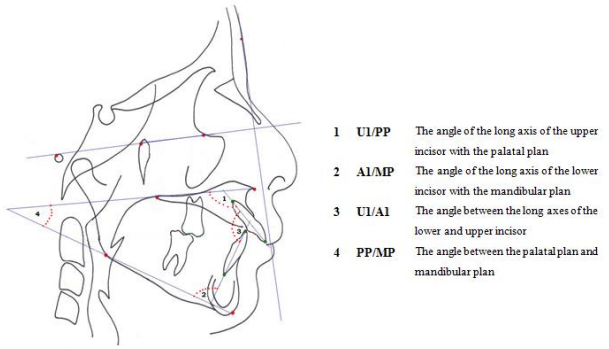

Fig.1. Visual cephalometric views used in the study

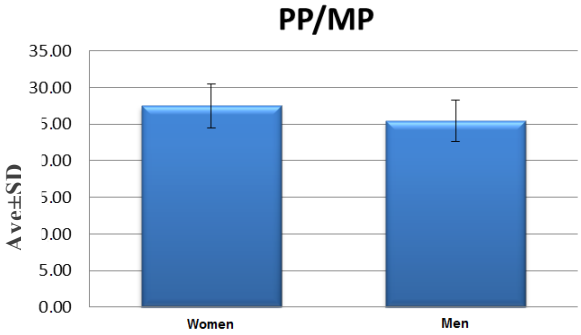

Fig.2. Distribution of PP/MP angle by gender

identification of the criminals; facial characteristics can be used for good identification. The face can be used to compare a photograph to reveal the face of a dead person using both morphological features and measurements, or to compare a photograph in case of misidentification or in case of missing persons (8,9). The proportions of human body vary depending on geography, race and age factors. Therefore, anthropometric and cephalometric studies conducted by many researchers are based on criteria such as racial groups, age and gender (10,11,12). Comparison of anthropometric and cephalometric results for healthy and sick individuals are used at forensics, plastic surgery, oral surgery, pediatrics, dentistry (12).

In this study, we aimed to reveal and compare gender-related changes of Class I individuals in four different cephalometric angles that were not previously done in our country.

Materials and Methods

This study was carried out between the dates of 2011-2013, and performed on right lateral cephalometric images of 80 healthy people (40 women, 40 men) with Class I skeletal (ANB=2.19±1.43) structure who applied to Çukurova University and Baskent University (Adana) Orthodontics of School of Dentistry Faculty. These images were selected from the cephalometric views of the master thesis project no: TF2013YL13. People who previously had orthodontic treatment, surgical procedures, congenital anomaly, abnormal growth and development, and trauma history were not included in the study. In addition, attention has been paid to the fact that the individuals included in the study have no missing teeth and that cephalometric films are of good quality. Besides of these, all participants and their families were chosen as people living in Turkey and Anatolia.

All images of cephalometric X-ray films were obtained under standard conditions, the teeth of subjects were in the centric occlusion, Frankfort Horizontal plane were against parallel to the floor, in the right side and the opposite side of subjects.

Plancema Cephalometry (PM 2002 EC Proline, Helsinki, Finland) device was used for each patient's images and evaluation of all images was done by the same investigator. All of the obtained cephalometric X-ray images were recorded in TIFF format in the computer and Image-J program was used for tissue parametric measurements. The 'angle tool' function is selected at the beginning of the measurements and all images taken from selected angles which are the angle of the long axis of the upper incisor with the palatal plan; U1/PP, the angle of the long axis of the lower incisor with the mandibular plan; A1/MP, the angle between the long axes of the lower and upper incisor; U1/A1, and the angle between the palatal plan and mandibular plan; PP/MP. All measurements were made and the measurement parameters are shown in (Figure 1). After each measurement, results were obtained from the 'Analyze> Measure' section. All data is stored in Image-J data and then transferred to Microsoft Excel program in electronic environment.

Statistical Analysis: When evaluating the findings obtained in this study, IBM SPSS Statistics 22 (SPSS IBM, software was used for statistical analysis. The normal distribution fitness of the variables was assessed by the Shapiro Wilks test and the data were found to be fit to normal distribution. Descriptive statistical methods (mean, standard deviation, frequency) and Student-t test were used in the inter-group evaluations when evaluating the study data. Pearson Correlation Analysis was used to evaluate the relationship between measurements. Significance was evaluated at the level of $p < 0.05$.

Results

Our study was performed on the right lateral cephalometric images of 80 healthy subjects, 50% (n=40) women and 50% (n=40) men. The ages of the individuals ranged from 21 to 71 years and the mean age was 42.61±14.05 years. 30% of the individuals (n=24) were under 30 years old, 70% (n=56) were The results of all angular measurements are shown in table 2. No statistically significant difference was

Table 1. The distribution of general characteristics of individuals (n=80)

		Min-Max	Ave±SD
Ages (years)		21-71	42.61±14.05
		n	%
Age groups	<30 years	24	30.0
	≥30 years	56	70.0
Gender	Women	40	50.0
	Men	40	50.0

Table 2. The distribution of angular measurements of individuals (n=80)

	Min-Max(0 degree) Ave±SD
U1/PP	95.33-132.11 (111.57±6.81)
A1/MP	71.15-96.70 (82.17±5.42)
U1/A1	124.41-166.22 (140.58±8.25)
PP/MP	19.42-33.92 (26.46±3.08)

Table 3. Evaluation of angular measurements by age groups

Angular Measurements	Age Groups		T	p
	<30 years (n=24)	≥30 years (n=56)		
	Ave±SD	Ave±SD		
U1/PP	112.51±7.22	111.17±6.65	0.805	0.423
A1/MP	81.61±5.01	82.42±5.61	-0.608	0.545
U1/A1	139.16±8.69	141.19±8.06	-1.006	0.318
PP/MP	25.65±2.46	26.81±3.27	-1.562	0.122

Student-t Test

over 30 years old; 50% (n=40) women, 50% (n=40) men (Table 1).

found between the U1/PP, A1/MP, U1/A1 and PP/MP values according to age groups (over 30 years old or under 30 years old) (p>0.05) (Table 3).

Comparison of cephalometric measurements and genders showed that there was no statistically significant difference between the values of U1/PP, A1/MP and U1/A1 (p>0.05) but angle of PP/MP of the women was higher than that of the men (p: 0.002; p<0.01) (Table 4 and Figure 2).

In Women: A statistically significant correlation was found between the U1/A1 and U1/PP cephalometric measurements in the negative direction at 51.6% level (r:-0.516, p: 0.001; p<0.01) (Table 5).

A statistically significant correlation was found between the PP/MP and U1/PP cephalometric measurements in the negative direction at 31.1% level (r:-0.311, p: 0.048; p<0.05) (Table 5).

A statistically significant correlation was found between the U1/A1 and A1/MP cephalometric measurements in the negative direction at 51.4% level (r:-0.514, p: 0.001; p<0.01) (Table 5).

In Men: A statistically significant correlation was found between the U1/A1 and U1/PP cephalometric measurements in the negative direction at 38.9 % level (r:-0.389, p:0.013; p<0.05) (Table 5).

A statistically significant correlation was found between the PP/MP and U1/PP cephalometric measurements in the negative direction at 33.3% level (r:-0.333, p:0.036; p<0.05) (Table 5).

A statistically significant correlation was found between the U1/A1 and A1/MP cephalometric measurements in the negative direction at 42.4% level (r:-0.424, p:0.001; p<0.01) (Table 5).

As a result of all the correlation analyzes, the highest correlation was found between U1/A1 and U1/PP values at 51.6% (Figure 3).

Discussion

Cephalometry was used before the science of orthodontics on anthropometric studies and examination of craniofacial development by making measurements on skulls. (13). In later years, this method was also used to determine congenital

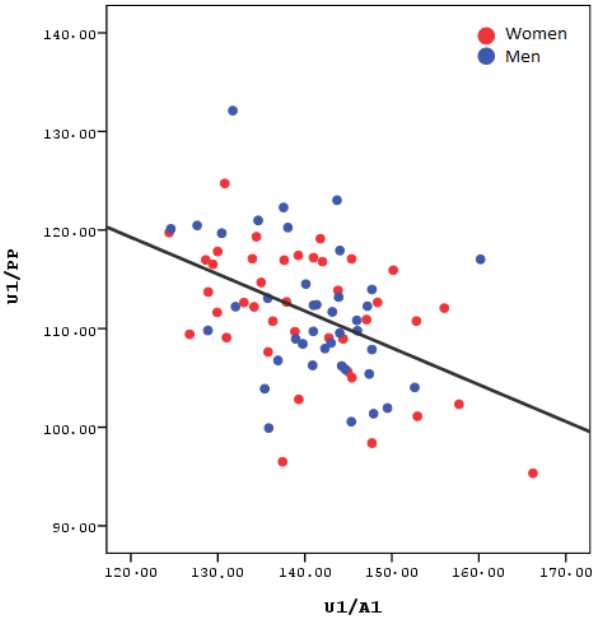

Fig. 3. Distribution of the relation between U1/PP angle and U1/A1 values by gender

craniofacial deformities, evaluation of the developmental process, orthodontic diagnosis and treatment process, and information during aesthetic surgical approaches. (14,15). In 1931, with the introduction of cephalometry, many researchers developed their own analytical methods to evaluate different parameters in orthodontic science (13,16,17,18). Each researcher determined the norm values of the measurements they used in cephalometric analysis for their societies. From this point, it is stated that direct application of cephalometric norms obtained for one race to individuals belonging to another race may cause incorrect evaluations. For this reason, separate cephalometric standards need to be introduced for each society (19,20,21). It is an important issue to investigate sex characteristics and to determine the gender differences in order to be able to reveal the norm values of societies (22,23). In this study, we aimed to reveal the sex-dependent changes of four different cephalometric values and to compare them with the norm.

The middle region of the face is regarded as an important area because it is a focus of interest at first sight. Therefore, the disproportion and symmetry disturbances observed in this region affect the view more negatively. There must be standard norms for any approach that is planned to correct this situation. In this regard, many researchers have attempted to reveal sex-related differences by making different cephalometric measurements on the face and mid-face regions. According to Burstone et al., the U1/PP angle, the angle of the long axis of the upper incisor with the palatal plan, is an ideal measurement for determining the position of the upper incisor in the maxilla (24). An ideal angulation with respect to the upper incisor base is an important condition for occlusion.

Fastlicht reported that the average value of this angle is 110° (1). According to Sangcharean and Ho, a change of 20° in the value of U1/PP angle causes a molar change of 1.8 mm in relation (25). In our study, the average U1/PP angle was 111.57±6.81° and the result was consistent with the mean value determined by Fastlicht for this angle. Abdulazeez and Köklü investigated the norms of Turkish society and this value is 109.70±5.62°, which corresponds to our study (2).

According to Fastlicht, adjusting the angle to 90° between the long axis of the lower incisor and the mandibular plan (A1/MP) is the main goal of every orthodontic treatment (1). For this reason, many researchers are planning orthodontic treatment considering A1/MP value. In our study the average of the A1/MP angle was determined as 82.17±5.42°. In a study investigating the norms of Turkish society, it was stated that this angle was 96.76±5.1° (2). In another study investigating the norms of Turkish society, the average A1/MP angle was 94.23±1.80° at rest (26). When we compare the results of our work and the norms of Turkish Society with Fastlicht findings, we can say that the angle of the long axis of the lower incisor with the mandibular plan is smaller than that of Fastlicht while the norm of the society is larger than Fastlicht's.

The angle (U1/A1) between the long axes of the lower and upper incisor correlates the position of the upper incisor with the position of the lower incisor (27). Fastlicht found that the mean value of this angle is 130°. When we consider Turkish society norms, we can say that this angle is 131.41±7.88° and it overlaps with the angular value that Fastlicht determined (1,2). When we consider results of our study against all these results, the mean value of the U1/A1 angle was found to be 140.58±8.25° and it was found to be larger than both the average value determined by Fastlicht and the norm of our society. According to these results, we can state that there is a wider angle between the upper incisor tooth and the lower incisor tooth in the population that we investigated, and we think that the result should be considered in the treatment plan according to the normal norm evaluation.

The PP/MP angle is the angle between the palatal plane and the mandibular plane and is an important criterion in determining the tendency to vertically anomaly (28,29,30,31,32,33). Fastlicht found that the average value of this angle is 30°. In our study, the average value of the PP/MP angle was determined as

Table 4. The distribution of cephalometric measurements by gender

	Gender		t	p
	Women (n=40) Ave±SD	Men (n=40) Ave±SD		
U1/PP	111.56±6.67	111.58±7.03	-0.018	0.986
A1/MP	81.44±6.57	82.90±3.90	-1.209	0.230
U1/A1	140.09±9.31	141.07±7.11	-0.533	0.595
PP/MP	27.49±2.99	25.44±2.86	3.138	0.002**

Student-t Test
***p<0.01*

Table 5. The correlation assessment of cephalometric values in women and men

Gender		Angular Measurements			
		U1/PP	A1/MP	U1/A1	PP/MP
		r; p	r; p	r; p	r; p
Women	U1/PP	1	-	-	-
	A1/MP	0.199; 0.466	1	-	-
	U1/A1	-0.516; 0.001**	-0.514; 0.001**	1	-
	PP/MP	-0.311; 0.048*	-0.279; 0.081	0.092; 0.572	1
Men	U1/PP	1	-	-	-
	A1/MP	-0.168; 0.300	1	-	-
	U1/A1	-0.389; 0.013*	-0.424; 0.006**	1	-
	PP/MP	-0.333; 0.036*	0.008; 0.0960	-0.049; 0.763	1

Pearson Correlation Analysis
**p<0.05 **p<0.01*

26.46±3.08° and was found to be close to the mean value determined by Fastlicht. When we consider the norms of Turkish society, it is determined that the angle between the palatal plane and the mandibular plane is 22.13±4.64° (2). In this case it can be stated that the angle between the jaw supports increases in the individuals with the mandibular anterior rotation model with increased posterior facial height, while it decreases in the posterior rotation model with increased anterior facial height (34).

In addition to researchers indicate that gender differences are important in cephalometric analysis, there are also researchers who argue that gender differences do not play an important role in cephalometric measurements in their studies (15,20,35). In the analysis of the cephalometric angular measurements, we showed that there is no sex-dependent difference between the U1/PP, A1/MP, U1/A1 angular measurement averages. ($p>0.05$). On the other hand, the mean of the maxillomandibular angle (PP/MP) in women was found to be significantly higher than that of men. (p: 0.002; $p<0.01$).

In the studies, maxillomandibular angle (PP/MP) was correlated negatively with angular and dimensional measurements that determine the sagittal positions of both maxillary and mandibular, and correlated positively with measurements with vertical growth (36,37,38). In another study, it was stated that the value of the angle (U1/PP) of the upper incisor with the palatal plane correlated positively with all the measurements that determine the lower jaw position (2). In our study, negative correlation was found between all angular measurements in both genders and all correlations were statistically significant. ($p<0.05$) (Table 5). Similar to our study, Abdulazeez and Köklü reported that the U1/A1 angle (angle between the incisors) showed a negative correlation between measurements in the vertical direction (2). Also in another study, correlatively our results, the angle between the lower incisor and the mandible (A1/MP) correlated negatively with both the size increase of the mandible and the positioning of the mandible (39).

Based on the results of this study; in addition to knowing the values of U1/PP, A1/MP, U1/A1 and PP/MP, gender should also be taken into account in such practices like surgical approaches, determining the most appropriate facial harmonics correctly, jaw surgery and aesthetic surgery applications, diagnosis and treatment, planning the outcome of surgical

outcomes. Our work continues by increasing the number of data.

Acknowledgements: Special thanks for valuable contribution of Research Assistant Ayca PAMUKCU who made the statistical analysis of our study.

References

1. Fastlicht J. A visual cephalometric analysis. J Clin Orthod. 2000; 68: 354-360.
2. Abdulazeez F, Köklü A. Fastlicht visual Sefalometrik analizinin toplumumuzdaki normları. Doktora tezi. T. C. Ankara Üniversitesi Sağlık Bilimleri Enstitüsü 2014; Ankara (in Turkish).
3. Lundström A, Forsberg CM, Peck S, McWilliam J. A proportional analysis of the soft tissue facial profile in young adults with normal occlusion. The Angle Orthodontist 1992; 62(2): 128-133.
4. Enöz M, Yanardağ H, Güven M. Osas'lı hastaların üst solunum yollarının değerlendirilmesindeki kullanılan teknikler. KBB-Forum 2006; 5(3) (in Turkish).
5. Uzel İ, Enacar A. Ortodontide Sefalometri. Yargıçoğlu Matbaası, 1. basım, İstanbul, 1984; 10-14 (in Turkish).
6. Ruhi N, Gökhan Ö. Arnett yumuşak doku sefalometrik analizi. S.D.Ü Sağlık Bilimleri Enstitüsü Dergisi 2012; 3(2): 96-102 (in Turkish).
7. Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning Part II. Am J Orthod Dentofacial Orthop 1993; 103:395-411.
8. Farkas LG, Hajnis K, Posnick JC. Anthropometric and anthroposcopic findings of the nasal and facial region in cleft patients before and after primary lip and palate repair. Cleft Palate Craniofac J 1993; 30: 1-12.
9. Farkas LG, Katic MJ, Forrest CR. International anthropometric study of facial morphology in various ethnic groups/races. J Craniofac Surg 2005; 16: 615-646.
10. Baral P, Lobo SW, Menezes RG, et al. An anthropometric study of facial height among four endogamous communities in the Sunsari district of Nepal. Singapore Med J 2010; 51(3): 212-215.
11. Jahanshahi M, Golalipour MJ, Heidari K. Theeffect of ethnicity on facial anthropometry in Northern Iran. Singapore Med J 2008; 49(11): 940-943.
12. Farkas LG, Tompson BD, Katic MJ, et al. Differences between direct (anthropometric) and indirect (cephalometric) measurements of the skull. J Craniofac Surg 2002; 13: 105-108.
13. Uzel İ, Enacar A. Ortodontide Sefalometri. Çukurova Üniversitesi Basımevi 2000; Adana (in Turkish).
14. Ülgen M. Ortodonti anomaliler, sefalometri, etiyoloji, büyüme ve gelişim, tanı. Ankara Üniversitesi Diş Hekimliği Fakültesi Yayınları Bölüm 8. 2001 Ankara (in Turkish).
15. Ajayi EO. Cephalometric norms of Nigerian children. Am J Orthod Dentofac Orthop 2005; 128: 653-656.
16. Ricketts RM, Schulhof RJ, Bagha L. Orientation Sella-Nasion or Frankfort Horizontal. Am J Orthod 1976; 69: 648-655.
17. Jacobson A. Application of witts appraisal. Am J Orthod 1976; 70: 179-198.
18. Steiner CC. Cephalometrics for you and me. Am J Orthod 1953; 39: 729-755.
19. Cotton WN, Takano WS, Wong WW. The downs analysis applied to three other ethnic groups. Angle Orthod 1951; 21: 213-20.
20. Ceylan İ, Gazilerli Ü. Erzurum yöresi çocuklarındaki Steiner, Downs ve Tweed ölçümlerinin diğer bazı gruplarla karşılaştırılması. A.Ü. Diş Hek Fak Derg 1992; 19: 143-152 (in Turkish).
21. Uysal T, Sarı Z. Posteroanterior Cephalometric norms in Turkish Adults. Am J Orthod Dentofacial Orthop 2005; 127: 324-32 (in Turkish).
22. Erbay EF, Caniklioğlu CM. Soft tissue profile in Anatolian Turkish adults: Part II. Comparison of different soft tissue analyses in the evaluation of beauty. Am J Orthod Dentofac Orthop 2002; 121: 65-72.
23. Wu J, Hagg U, Rabie ABM. Chinese norms of McNamara's Cephalometric Analysis. Angle Orthod 2007; 77: 12-20.
24. Burstone C, James R, Legan H, Murphy G, Norton L. Cephalometrics For Orthognathic Surgery. J Oral Surg 1978; 36: 269–277.
25. Sangcharearn Y, Ho C. Maxillary incisor angulation and its effect on molar relationship. Angle Orthod 2007; 77(2): 221-225.
26. Uner O. The Roentgeno cephalometric differences between occlusion and rest position of the mandible in tweed triangle. Journal of Istanbul University Faculty of Dentisry 1974; vol:8 no:3.
27. Ellis E, Mcnamara JA. Cephalometric evaluation of incisor position. Angle Orthod 1986; 56: 324–344.
28. Müller G. Growth and development of the middle face. J Dent Res 1963; 42: 385-399.
29. Sassouni V. A classification of skeletal facial types. Am J Orthod 1969; 55: 109-123.
30. Nahoum HI, Horowitz SL, Benedicto EA. Varieties of anterior openbite. Am J Orthod Dentofac Orthop 1972; 61: 486-92.
31. Kim YH. Overbite depth indicator with particular reference to anterior openbite. Am J Orthod. Dentofac Orthop 1974; 65(6): 586-611.

32. Schendel SA, Eisenfeld J, Bell WH, Epker B, Misholovich DJ. The long face syndrome: Vertical maxillary excess. Am J Orthod 1976; 70: 398-408.
33. Trouten JC, Enlow DH, Rabine M, Phelps AE, Swedlow D. Morphologic factors in openbite and deepbite. Angle Orthod 1983; 53: 192-211.
34. Öz U, Rübendüz M. Farklı rotasyon modellerine sahip sınıf II, 1 maloklüzyonlu bireyler ile sınıf I bireyler arasındaki dentoalveolar ve kraniyofasiyal yapı farklılıklarının değerlendirilmesi. Doktora tezi. T. C. Ankara Üniversitesi Sağlık Bilimleri Enstitüsü 2009; Ankara (in Turkish).
35. Gürsoy N, Uğur T, Gürsoy S. Normal kapanışlı Türklerde
sefalometrik norm araştırması. I.Ü. Diş Hek Fak Derg 1973; 7: 333-343 (in Turkish).
36. Bishara SE, Augspurger EF. The role of mandibular plane
inclination in orthodontic diagnosis. Angle Orthod 1975; 45: 273–281.
37. Opdebeeck H, Bell WH, Eisenfeld J, Mishelevich D.
Comparative study between the SFS and LFS rotation as a possible
morphogenic mechanism. Am J Orthod Dentofac Orthop 1978; 74: 509-521.
38. Siriwat PP, Jarabak JR. Malocclusion and facial morphology is there
a relationship? Angle Orthod 1985; 55: 127-138.
39. Ishikawa H, Nakamura S, Iwasaki H, Kitazawa S, Tsukada H, Sato Y. Dentoalveolar compensation related to variations in sagittal jaw
relationships. Angle Orthod 1999; 69: 534-538.