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" عَلاقَةُ زاوِيةِ نُورْدِفَالْ مَعَ مُورْفُولُوجِيَا النُّمُوّ الدَّوَرَانِيّ الوَجْهِي فِي مَرْحَلَةِ الإِطْبَاقِ الدَّائِمِ لَدَى الإِنَاثِ: دِرَاسَةٌ سَيْفَالُومِتْرِيَّةٌ."

د. يزن جحجاح*

(تاريخ الإيداع ٨/١/ ٢٠٢٤ – تاريخ النشر ٢٨/١/ ٢٠٢٥)

□ ملخّص □

تتميز بنية وجوه الإناث بعناصر مختلفة تعزز جماله، حيث يحتل الارتفاق الذقني مكانة مهمة بينها. تعترف العديد من الدراسات بالعلاقة بين شكل الارتفاق الذقني للفك السفلي وأنواع النمو الدوراني المختلفة للوجه. ومع ذلك، فإن زاوية نوردرفال (وهي الزاوية المعروفة باسم N-angle، والتي تستخدم لقياس ميلان الارتفاق وتحديد بروز الذقن العظمي بالنسبة لمستوى الفك السفلي) لم يتم اعتمادها في هذه التحاليل، على الرغم من أخذها بعين الاعتبار في العديد من دراسات النمو.

هدف البحث: يهدف هذا البحث إلى تقييم العلاقة بين زاوية نوردرفال وشكل النمو الدوراني للوجه وذلك وفقًا لتحليل القياسات السيفالومترية لجاراباك لدى الإناث خلال مرحلة الإطباق الدائم.

مواد وطرق البحث: شملت الدراسة صور شعاعية سيفالومترية جانبية لـ ٥٣ مريضة ما قبل المعالجة التقويمية، تراوحت أعمارهن ما بين ١٥ إلى ٢١ عامًا، حيث تمت دراستها رقميًا. وحساب معامل ارتباط بيرسون للتحقق من قوة العلاقة الخطية بين "زاوية نوردرفال" وكل من المتغيرات القياسية الأخرى التي تميز الصفات الشكلية للنمو الدوراني الوجهي.

النتائج: كشفت حسابات الارتباط درجات تباين مختلفة للعلاقة ما بين المتغيرات القياسية المختلفة التي تميز الصفات الشكلية للنمو الدوراني الوجهي المجراة في سياق هذه الدراسة من جهة، وبين "زاوية نوردرفال" من جهة أخرى. لقد أبدت زاوية مستوى الفك السفلي أعلى ارتباط إيجابي مع "زاوية نوردرفال"، بينما أظهرت نسبة الارتفاع الوجهي أعلى ارتباط سلبي مع "زاوية نوردرفال".

الخلاصة: يمكن استخدام زاوية نوردرفال كمشعر سيفالومتري للصفات الشكلية للنمو الدوراني الوجهي لدى الإناث، ولكن بحذر.

كلمات مفتاحية: زاوية نوردرفال، N-angle، التحليل السيفالومتري حسب جاراباك، الصفات الشكلية للنمو الدوراني الوجهي لدى الإناث ، الإطباق الدائم.

* أستاذ مساعد ورئيس قسم تقويم الأسنان والفكين –كلية طب الأسنان – جامعة طرطوس yazanjahjah@gmail.com

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"The Relationship of Norderval Angle with Facial Rotational Growth Morphology in Females During Permanent Occlusion: A Cephalometric Study."

Dr. Yazan Jahjah *

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□ABSTRACT □

The structure of the females' faces is characterized by various elements that enhance its beauty, with the mandibular symphysis holding a significant position among them. Several studies acknowledge the relationship between the morphology of the mandibular symphysis and different facial types of rotational growth. Nevertheless, the Norderval angle (an angle termed the N-angle, used to measure the inclination of the symphysis and indicate the prominence of the bony chin relative to the mandibular plane) was not included in these analyses, despite being considered in several growth studies.

Aim The aim of this study is to evaluate the correlation between the Norderval angle and facial rotational growth morphology according to Jarabak cephalometric analysis in females during the permanent occlusion phase.

Materials and methods: Lateral cephalometric radiographs of 53 female pre-orthodontic patients, aged 15 to 21 years, were included and digitally studied. Pearson's correlation coefficient was calculated to investigate the strength of the linear relationship between the "Norderval angle" and each of the other dependent cephalometric variables that characterize facial rotational growth morphology.

Results:The calculated correlations highlight the varying degrees of association between different cephalometric variables that characterize facial rotational growth morphology and the "Norderval angle" in the context of the study. The Mandibular Plane Angle shows the highest positive correlation with the "Norderval angle," while the " Facial Height Ratio " exhibits the highest negative correlation with the "Norderval angle.".

Conclusions the Norderval angle can be utilized as a cephalometric indicator of facial rotational growth morphology in females, albeit cautiously.

Key Words: Norderval angle, N- angle, Jarabak cephalometric analysis, facial rotational growth morphology in females, permanent occlusion.

* Assistant Professor and Head of the Department of Orthodontics and Dentofacial Orthopedics at the Faculty of Dentistry, Tartous University. yazanjahjah@gmail.com

Introduction

The anatomical morphology of the female face is distinguished by several features that contribute to its aesthetic appeal, among which the mandibular symphysis, plays a pivotal role. The mandibular symphysis is crucial for defining the contour and symmetry of the lower face, which significantly impacts facial attractiveness. Recent studies emphasize the importance of the mandibular symphysis in orthodontic and maxillofacial assessments, noting that its size, shape, and projection are critical factors in the overall perception of facial attractiveness A retrusive or excessively prominent chin can disrupt facial harmony, necessitating clinical interventions to achieve a more balanced appearance [1]. In his 1971 thesis, Norderval introduced an angle, termed the N-angle, to measure the inclination of the symphysis and indicate the prominence of the bony chin relative to the mandibular plane [2]. Björk observed that a propensity for posterior mandibular rotation is linked to a noticeable apposition beneath the symphysis, contributing to a general concavity along the lower mandibular border. The symphyseal inclination with proclination serves as an indicator of a mandible rotating backward influencing facial morphology [3,4]. However, Skieller and Björk assess the Inclination of the symphysis in relation to the Nasion-Sella Line (NSL) [5], rather than using the mandibular plane as Norderval did. Steiner acknowledged the significant role of the chin in shaping the facial profile. He posited that the chin essentially defines the character of the lower face. The prominence of the chin, he argued, should be a major factor in determining the positioning of the teeth. Additionally, Steiner observed that the prominence of the mandibular symphysis could potentially affect the interpretation of skeletal relationships [6,7]. Hansud sought to define facial morphology by applying Steiner's concepts, focusing on the assessment of mandibular position and chin prominence influenced by the mandibular symphysis. He referenced the Norderval angle, acknowledging that the N-angle provided a more accurate description of the bony chin configuration [8]. Nevertheless, analyses focusing on evaluating facial morphology, such as those by Hansud [8] and Jarabak [9], did not utilize this angle. However, Jarabak's work stood out by examining facial morphology patterns commonly associated with rotational growth changes. These patterns tend to highlight characteristic features with growth, making even static evaluations identify in terms of growth. This is specifically why the current research focuses on studying the relationship between the Norderval angle and facial rotational growth morphology using the Jarabak cephalometric analysis.

Study Objectives

The objective of this study is to evaluate the correlation between the Norderval angle and facial rotational growth morphology according to Jarabak cephalometric analysis in females during the permanent occlusion phase.

MATERIALS AND METHODS

Subjects.

The research utilized lateral cephalometric radiographs of 53 female pre-orthodontic patients, whose ages ranged from 15 to 21 years. The selection criteria for the subjects included fully erupted permanent teeth up to the second molars with no history of TMJ, dental trauma or previous orthodontic treatment. All subjects with any type of hypodontia or hyperdontia, dental attrition, premature occlusal contacts, functional mandibular deviations, posterior and/or anterior crossbites, dentoskeletal asymmetries, systemic diseases, congenital anomalies/syndromes.

Ethical Considerations

The risks and benefits were explained to each patient, and those who provided appropriate consent were enrolled in this study.

Sample estimation

To ensure that the statistical model of the study accurately represents the data without systematic errors, an autocorrelation analysis of the residuals using the Durbin-Watson test.

Table 1 The Durbin-Watson test of the dataset of current study.

Autocorrelation	Statistics	p
-0.15	2.28	.385

The results of the Durbin-Watson test revealed that the null hypothesis of zero autocorrelation is not rejected, indicating no significant autocorrelation among residuals. The Durbin-Watson statistic of 2.28 suggests random prediction errors rather than systematic ones. This implies that the model's predictions are robust, supporting reliable clinical decision-making and indicating no omitted variables or unaddressed temporal effects compromising model integrity.

Method error:

All cephalometric measurements were repeated twice with a minimum interval of one month by the author. The initial measurements and the repeated measurements were compared by using a paired t-test to check for any systematic error. The t-test at the 05 level showed no statistical significance. This indicates that the measurements were reproducible.

lateral cephalometric study:

All lateral cephalometric radiographs were obtained using a cephalostat, with subjects positioned in maximal Intercuspation with lips at rest. A single investigator conducted both the digital tracing of the lateral cephalograms and their subsequent digital cephalometric measurements using the AudaxCeph® software.

The Norderval angle (N-angle) is created by the intersection of the Mandibular line (ML) and a tangent that connects point B (B-point) to pogonion (Pg) [2,8,10]. The Mandibular line (ML) is a tangent line running from gnathion (Gn) to the inferior border of the mandibular angle.

Clinically, a smaller Norderval angle indicates greater prominence of the bony chin relative to the mandibular plane, and vice versa.

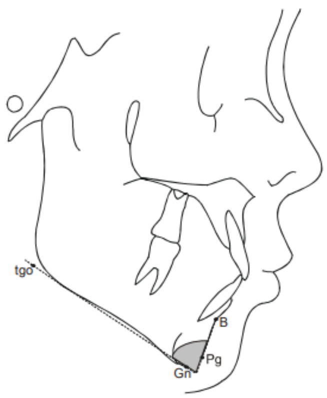

Figure 1 Norderval angle. Adapted from Sevilla-Naranjilla, M. A. (2004).[9]

It should be noted that according to Norderval, gnathion (Gn) is the lowest point of the mandibular symphysis [2], a point that Jarabak refers to as Menton (Me) [9]. Conversely, Jarabak defines gnathion (Gn) as the most anterior and inferior point on the bony chin, located at the junction of the lower border of the mandible and the mandibular symphysis [11]. In the current study, we will primarily use the cephalometric descriptions according to Jarabak [9] and Downs [12]. Accordingly, to assess the facial morphology typically associated with rotational growth changes, the following cephalometric measurements were selected and performed in this study:

Table 2 the conducted Cephalometric variables that characterize facial rotational growth morphology.

Abbreviation	Name and description	Notes
N S Ar	Saddle Angle	An angle between anterior and posterior cranial base, formed between (Nasion)- (Sella)-(Articulare).
S Ar Go	Articular Angle	formed between (Sella)-(Articulare)- (Go)
Ar Go Me	Gonial Angle	Angle formed between (Articulare)-(Gonion)- (Menton)
∑ Bjork	Sum of Bjork polygon angles	the Sum of saddle, articular and gonial angles
Y-axis angle	Downs's Y-axis angle	The angle formed between the line connecting sella (S) to gnathion (Gn) and the S-N line.
NGoAr	Upper Gonial Angle	an angle between ramus height and (Gonio)-(Nasion) line.
NGoMe	Lower Gonial Angle	mandibular plane and (Gonio)-(Nasion) line
SNA	Maxillary Prognathism angle	the anteroposterior position of point A in relation to the cranial base
SNB	mandibular prognathism angle	describes the anteroposterior position of the mandible in relation to the cranial base.
ANB	Angle of Maxillo-Mandibular Differential	describes the skeletal anteroposterior relationship between the maxilla and mandible
SNPog	Facial Angle	Evaluating the anteroposterior relationship between the cranial base and the prominence of the mandible
NAPog	Angle of convexity	Evaluating the facial convexity
Facial Height Ratio or Jarabak quotient	**FHR**=S-Goc/N-Me	**FHR** : the ratio of posterior (S-Go) to anterior face height (N-Me)
N-S:SPP	Palatal Plane Angle or PP Angle	N-S/Palatal Plane: The angle formed by the intersection of the N-S and SPP planes
N-S:Go-ME	Mandibular Plane Angle	The angle formed by the intersection of the N-S and Go-Me planes
Go-ME – SPP	The basal angle: Palatal/Mandibular Plane Angle	The angle formed by the intersection of the Go-ME and SPP planes

Studying facial rotational growth morphology, Jarabak categorized facial morphology on the basis of three patterns mainly defined by using a facial polygon beside the Facial Height Ratio (FHR), or Jarabak quotient. These patterns are commonly associated with rotational growth changes that tend to accentuate the pattern characteristics with growth, so even static evaluations are identified in terms of growth, as follows [9,11]:

Table 3: Cephalometric indicators of facial rotational growth morphology according to Jarabak [9,11]:

Value of the parameter	facial growth pattern	Value of the parameter	Rotational direction
FHR < 59%	Hyperdivergent	∑ Bjork > 396°	posterior growth pattern
FHR 59%-63%	Neutral	∑ Bjork = 396 ∓ 6	normal growth pattern
FHR > 63%	Hypodivergent	∑ Bjork < 396°	anterior growth pattern

Statistical method:

All statistical analyses for this study were conducted using IBM SPSS Statistics, Version *29.0.2.0 (20).* Below are descriptive statistics on the age of sample subjects:

Table 4 descriptive statistics on the age of sample subjects

age	
Mean	16.42
Standard Error	0.23
Median	16.00
Mode	16.00
Standard Deviation	1.68
Sample Variance	2.82
Range	6.00
Minimum	15.00
Maximum	21.00
Count	53.00

***Study data analysis design*:**

Pearson's correlation coefficient was calculated to investigate the strength of the linear relationship between "Norderval angle" and each of the other dependent cephalometric variables that characterize facial rotational growth morphology:

N-S:SPP, N-S:Go-ME, N S Ar, S Ar Go, Ar Go Me, ∑ Bjork, Y-axis angle, NGoAr, NGoMe, Go-ME – SPP, SNA, SNB, ANB, SNPog, NAPog, and Jarabak quotient.

Statistical hypotheses of the study:

Null Hypothesis (H_0): There is no significant linear relationship between "Norderval angle" and each of the other dependent cephalometric variables that characterize facial rotational growth morphology N-S:SPP, N-S:Go-ME, N S Ar, S Ar Go, Ar Go Me, ∑ Bjork, Y-axis angle, NGoAr, NGoMe, Go-ME – SPP, SNA, SNB, ANB, SNPog, NAPog, and Jarabak quotient. The null hypothesis suggests that the correlation between "Norderval angle" and each parameter is zero, implying no linear relationship.

Alternative Hypothesis (H_1): There exists a significant linear relationship between "Norderval angle" and at least one of the other cephalometric variables that characterize facial rotational growth morphology (N-S:SPP, N-S:Go-ME, N S Ar, S Ar Go, Ar Go Me, ∑ Bjork, Y-axis angle, NGoAr, NGoMe, Go-ME – SPP, SNA, SNB, ANB, SNPog, NAPog, and Jarabak quotient.). The alternative hypothesis implies that there is a non-zero correlation, indicating the presence of a linear relationship between "Norderval angle" and at least one other parameter.

RESULTS

Descriptive statistics were conducted for Norderval angle in addition to all examined cephalometric variables that characterize facial rotational growth morphology, including N-S ،N-S, N S Ar, S Ar Go, Ar Go Me, ∑ Bjork, Y-axis angle, NGoAr, NGoMe, Go-ME – SPP, SNA, SNB, ANB, SNPog, NAPog, Jarabak quotient, and Norderval angle.

Table 5 Table 4 Descriptive statistics for all the examined cephalometric variables.

	Mean	Std. Deviation	Minimum	Maximum
N-S:SPP	9.29	3.67	0.8	17.01

N-S:Go-ME	35.58	6.4	18.37	52.46
N S Ar	127.16	5.72	114.22	139.09
S Ar Go	144.86	7.12	131.46	158.29
Ar Go Me	123.55	5.91	112.91	133.92
∑ Bjork	395.58	6.4	378.37	412.46
Y-axis angle	70.06	4.48	61.52	82.17
NGoAr	49.75	4.35	40.87	61.42
NGoMe	73.81	5.39	58.62	89.15
Go-ME – SPP	26.28	6.27	13.06	42.28
SNA	81.03	4.03	72.77	92.83
SNB	76.8	4.01	67.77	87.85
ANB	4.23	2.45	-1.95	10.47
SNPog	77.39	4.11	68.06	87.95
NAPog	187.65	5.8	172.11	200.55
Jarabak quotient	63.9	4.89	53.33	78.32
Norderval angle	62.21	6.49	48.14	82.98

Pearson’s correlation coefficient was calculated to investigate the strength of the linear relationship between the "Norderval angle". and each of the dependent cephalometric variables that characterize facial rotational growth morphology: N-S:SPP, N-S:Go-ME, N S Ar, S Ar Go, Ar Go Me, ∑ Bjork, Y-axis angle, NGoAr, NGoMe, Go-ME – SPP, SNA, SNB, ANB, SNPog, NAPog, and Jarabak quotient.

Table 6 Pearson’s correlation coefficient was calculated to investigate the strength of the linear relationship between the "Norderval angle". and each of the dependent variables.

	Norderval angle	*correlation Strength*	
Jarabak quotient	-0.34	moderate negative correlation	⇩⇩⇩
Go-ME – SPP	-0.33		
N S Ar	-0.3		
Ar Go Me	-0.27		
SNPog	-0.21	weak negative correlation	⇩⇩
SNA	-0.19		
SNB	-0.15		
NGoMe	-0.14		
S Ar Go	-0.13		
NAPog	-0.13		
NGoAr	-0.12		
ANB	-0.08	very weak negative correlation	⇩
∑ Bjork	-0.03		
Y-axis angle	0	no correlation	⊗
N-S:SPP	0.04	Very weak positive correlation	⇧
N-S:Go-ME	0.3	moderate positive correlation	⇧⇧⇧

According to the results of the Pearson's correlation coefficient calculated to investigate the strength of the linear relationship between the 'Norderval angle' and each of the dependent variables listed in (Table 6). A diagram was created to visually illustrate the strength of the calculated linear correlations.

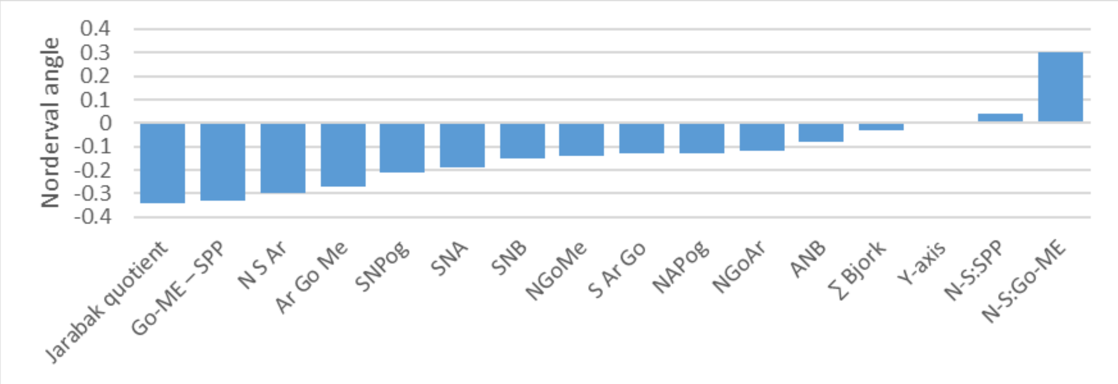

Figure 2

Based on the results of Pearson's correlation coefficient analysis, the "N-S:Go-ME" variable shows the highest positive correlation with the "Norderval angle" (r = 0.3), while the "Jarabak quotient" exhibits the highest negative correlation with the "Norderval angle" (r = -0.34). Additionally:

- N-S:SPP and ∑ Bjork and ANB: have a Very weak positive correlation
- N S Ar, Ar Go Me, Go-ME – SPP, and "Jarabak quotient" show moderate negative correlation.
- S Ar Go, NGoAr, NGoMe, SNA, SNB, SNPog, and NAPog, exhibit weak negative correlation
- "N-S:Go-ME" has moderate positive correlation
- The " Y-axis " angle shows no correlation.

These correlations highlight the varying degrees of association between different cephalometric variables that characterize facial rotational growth morphology and the "Norderval angle" in the context of the study.

DISCUSSION

The morphology of the mandibular symphysis has a significant influence on the perception of facial attractiveness, particularly in females. Numerous studies have investigated this feature from different perspectives using a variety of methodologies [6,8,9,13,14,15,16]. The present study aims to evaluate how the Norderval angle correlates with facial rotational growth morphology according to the Jarabak analysis in females during the permanent occlusion phase. To investigate the strength of the linear relationship between the "Norderval angle" and each of the dependent cephalometric variables characterising the facial rotational growth morphology suggested by Jarabak, Pearson's correlation coefficient was calculated (see Table 6, & Figure 2) results showing that Mandibular Plane Angle (N-S:Go-ME) exhibits the highest positive correlation with the "Norderval angle. Taking into consideration that a higher Norderval angle value corresponds to less chin prominence and vice versa, this result implies that as the Mandibular Plane Angle increases, the Norderval angle also increases, leading to reduced chin prominence. This means that when the mandible rotates posteriorly during the growth in females with a hyperdivergent growth pattern, the chin compensates by reducing its projection. This adjustment prevents an increase in vertical facial height, leading to a less pronounced vertical dimension, which is highly desirable for achieving a harmonious feminine face. This was similar to Aki et al's findings [16]. Furthermore, these particular results suggest that anterior mandibular rotation in females with a hypodivergent growth pattern is associated with a more prominent chin, which is consistent with the findings of Björk [3,4,5] , and Jarabak [9].

There is a moderate relationship between the inclination of the symphysis angle, as defined by Norderval, and the direction of facial rotational growth in females.

According to the results of Pearson's correlation coefficient (refer to Table 6 and Figure 2), the Saddle Angle, Gonial Angle, basal angle, and 'Jarabak quotient' exhibit a moderate negative correlation with the 'Norderval angle', with the 'Jarabak quotient' showing a particularly noteworthy negative correlation among these parameters. This indicates that chin projection is linked positively to the overall facial divergence type in females. Therefore, females with hypodivergent faces have a tendency for a smoother vertical growth of the chin. This is supported by Marghalani et al. [17], who stated that hypodivergent individuals tend to exhibit smaller changes in chin volume and a more controlled vertical growth pattern, which aligns with their overall craniofacial morphology characterized by a less pronounced vertical dimension compared to hyperdivergent individuals.

CONCLUSION

The present study evaluated the correlation between the Norderval angle and facial rotational growth morphology according to Jarabak analysis in females during the permanent occlusion phase revealing:

1. A varying degree of association between different cephalometric variables that characterize facial rotational growth morphology and the "Norderval angle"
2. . The Mandibular Plane Angle (N-S:Go-ME) shows the strongest positive correlation with the "Norderval angle.
3. In females with a hyperdivergent growth pattern, the chin adapts to posterior mandibular rotation by decreasing its projection.
4. Norderval angle correlations indicated that chin projection was positively (but moderately) associated with overall type of facial divergence.

In summary, the Norderval angle can be utilized as a cephalometric indicator of facial rotational growth morphology in females, albeit cautiously. Future studies should prioritise the expansion of the sample size and the integration of more advanced techniques of investigation to further clarify the relationship between the Norderval angle and the facial rotational growth pattern in females.

REFERENCES

1. Rosati, R., Martina, S., & Rongo, R. (2020). *Cephalometric norms for orthognathic surgery in the Italian population: Skeletal, dental and soft tissue values in the General and 'cutoff' patient group*s. Journal of Craniomaxillofacial Sur*gery, 48*(5), 479-486.
2. Norderval, K. (1971). *Arch space and cephalometric evaluation of a group of Norwegian adults with ideal occlusion* (Thesis). University of Bergen. 1
3. Björk, A. (1947). *The face in profile. Svensk T*andläk Tidskr, 40(Suppl 5B), 55-66. 2
4. Björk, A. (1969). *Prediction of mandibular growth rotation*. *American Journal of Orthodontics,* 55, 585-599. 3
5. Skieller, V., Björk, A., & Linde-Hansen, T. (1984). *Prediction of mandibular growth rotation evaluated from a longitudinal implant sample.* American Journal of Orthodontics, 86*(5), 359–370. 4*

6. Steiner, C. C. (1953). *Cephalometrics for you and m*e. American Journal of Orthodontics, 39(10), 729-755 5
7. Steiner, C. C. (1959). *Cephalometrics in clinical practice*. Angle Orthodontist, 29(1), 8-29 6
8. Hasund, A., & Böe, O. E. (1980). *Floating norms as guidance for the position of the lower incisors.* The Angle Ortho*dontist*, *50*(3), 165-168. 7
9. Siriwat, P. P., & Jarabak, J. R. (1985). *Malocclusion and facial morphology: Is there a relationship? An epidemiologic stud*y. Angle Orthodontist*, 55*(2), 127-138. 8
10. Sevilla-Naranjilla, M. A. (2004). *Cranial morphology of Filipino and German subjects with Angle Class I occlusion: A cephalometric study* (Doctoral dissertation, Ludwig Maximilian University of Munich). Clinic for Orthodontics – Downtown, Director: Prof. Dr. Ingrid Rudzki-Janson. 9
11. Jarabak, J. R., & Fizzell, J. A. (1972*). Technique and Treatment with Light-wire Edgewise Appliances.* Mosby. 10
12. Downs, W. B. (1948*). Variations in facial relationships: Their significance in treatment and prognosis.* American Journal of Orthodontics and Oral Surgery*, 34*(10), 812-840. 11
13. Bresin, A., & Forsberg, C. M. (2021*). The influence of chin prominence on perceived attractiveness in profiles: A study using digitally manipulated images*. Journal of Esthetic and Restorative Dentistry, 33(1), 54-61.
14. Erol, Y. E., Arun, T., & Isik, F. (2019). *Three-dimensional evaluation of facial soft tissue changes after orthognathic surgery*. American Journal of Orthodontics and Dentofacial Orthopedics, 155(2), 211-218.
15. Naini, F. B., Moss, J. P., Gill, D. S., & Al-Bitar, Z. B. (2008*). The enigma of facial beauty: Esthetics, proportions, deformity, and controvers*y. American Journal of Orthodontics and Dentofacial Orthopedics, 133(6), 678-682.
16. Aki, T., Nanda, R. S., Currier, G. F., & Nanda, S. K. (1994). *Assessment of symphysis morphology as a predictor of the direction of mandibular growth*. American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics, 106(1), 60–69
17. Marghalani, H. Y. A., Guan, G., Hyun, P., Tabbaa, S., Linjawi, A. I., & Al-Jewair, T. (2022). *Relationship between mandibular symphysis dimensions and skeletal pattern in adults*. Folia Morphologica*, 81*(2), 464–471.