

## Evaluation the Actual and Effective Symphysis to Detect the Direction of Mandibular Rotation in Iraqi Sample (Cephalometric Study)

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### Key words

actual symphysis, effective symphysis, mandibular rotation.

### Abstract

This study is attempted to find out if the actual and effective symphysis are correlated with the measurements of mandibular rotation and can be used to detect the direction of mandibular growth. Ninety five Iraqi adult patients (54 females and 41 males) with an age ranged between 18-31 years collected among patients having Class I skeletal and occlusal relations and full permanent dentition regardless the third molars were chosen for this study. Each person was subjected to clinical examination and digital true lateral cephalometric radiograph. The radiographs were analyzed by using AutoCAD 2007 computer program to measure the two symphyseal measurements with eleven measurements for mandibular rotation. Descriptive statistics were obtained from the measurements of both genders; independent samples t-test was performed to evaluate the gender differences, while Pearson's correlation coefficient test was used to find the correlation of actual and effective symphysis with the mandibular rotation measurements. Actual and effective symphysis were not significantly differing between genders, while facial heights were significantly higher in males. Regarding the mandibular rotation angles, only SN-MP, saddle (N-S-Ar), and the sum of the posterior angles (Sum PA) were significantly higher in females, while PP-MP, FMA, articular (S-Ar-Go), and gonial (Ar-Go-Me) angles showed non-significant higher mean values in males. For both genders and the total sample, the actual symphysis didn't show any significant correlation with the facial heights and the mandibular rotation angles, on the contrary the effective symphysis showed in both genders and the total sample significant positive correlations with Jarabak ratio, and significant negative correlations with SN-MP, PP-MP, FMA, and the sum of the posterior angles. In males and the total samples, the saddle angle (N-S-Ar) significantly positively correlated with the effective symphysis, while gonial angle (Ar-Go-Me) was significantly negatively correlated with it. Articular angle (S-Ar-Go) only significantly negatively correlated with the effective symphysis in the total sample. Effective symphysis is a good predictor of the direction of mandibular rotation, while actual symphysis is a poor predictor.

### Introduction

The mandibular symphysis is orthodontically defined as the area

covering the mandibular symphyseal region on the lateral cephalogram<sup>(1)</sup>. It is one of the most important regions of the craniofacial complex, serves as a primary

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reference for esthetic considerations in the lower third of the face. An understanding of the structure and function of basal and alveolar bone, which ultimately requires description and explanation of ontogenetic variation in symphyseal morphology, is therefore essential in order to develop a differential diagnosis<sup>(2)</sup>. It has been reported that morphological changes in the mandibular symphysis are associated with mandibular growth<sup>(2, 3)</sup> as well as types of malocclusion<sup>(4)</sup> and orthodontic treatments<sup>(3, 5)</sup>. Ricketts<sup>(6)</sup> stated that symphysis morphology may be used to predict the direction of mandibular growth. On a qualitative basis, he associated a thick symphysis with an anterior growth direction. Likewise, other investigators reported similar observations<sup>(7, 8)</sup>. Bjork<sup>(7)</sup> with his implant studies described multiple structural signs seen in extreme types of mandibular rotators. The forward inclination of the condylar head was associated with forward mandibular rotators, along with a greater curvature of the mandibular canal than the mandibular contour. A tendency toward backward mandibular rotation is associated with a pronounced apposition below the symphysis with more overall concavity of the lower mandibular border. An inclination of the symphysis with proclination is an indicator of a backward rotating mandible. Although many cephalometric measurements have been used, it has been shown that it is still very difficult to accurately predict the direction of mandibular growth<sup>(9)</sup>. The factors associated with the symphyseal growth and morphology include the functional neuroskeletal balance,<sup>(10)</sup> masseter muscle thickness,<sup>(11)</sup> mandibular plane angle,<sup>(12,13)</sup> overbite,<sup>(10,14,15)</sup> lower incisor angle,<sup>(16)</sup> occlusal hypofunction and its recovery,<sup>(17)</sup> inheritance,<sup>(18)</sup> and more<sup>(19)</sup>. Schudy<sup>(20)</sup> mentioned two definitions for the symphysis: Actual symphysis which is the portion of the mandible that lies anterior to a line perpendicular to the mandibular plane, passing through point B. This is measured parallel to the mandibular plane. Effective symphysis which is the portion of the mandible that lies anterior to a continuation of line NB, measured perpendicular to line NB. This study is the

first study that attempted to find out if the actual and effective symphysis are correlated with the measurements of mandibular rotation and can be used to detect the direction of mandibular growth.

## Material and Methods

### The Sample

The sample included patients at the Smiles Dental Center. Their age ranged between 18-31 years. Ninety five subjects (54 females and 41 males) were selected to have Class I sagittal skeletal relationship according to Riedel<sup>(21)</sup> (ANB angle  $2^{\circ} \pm 2$ ), normal Angle Class I occlusion, full permanent dentition regardless the third molars. They were clinically healthy with no syndromes, and no evidence of craniofacial anomalies, such as a cleft lip and palate. None had a history facial trauma or previous orthodontic, orthopedic or surgical treatment.

### Method

Each patient was examined clinically and subjected to the true digital lateral cephalometric radiograph by using Carestream Kodak CS9000c 3D radiograph unit. The individual was positioned within the cephalostat with the sagittal plane of the head vertical, the Frankfort plane horizontal, and the teeth were in centric occlusion. Every lateral cephalometric radiograph was analyzed by AutoCAD 2007 analyzing software computer program to calculate the linear and angular measurements. Once the picture is imported to the AutoCAD program, it will appear in the master sheet on which the points and planes were determined, and then the angular and linear measurements were obtained. The angles were measured directly as they were not affected by magnifications, while the linear measurements were divided by scale (the ruler in the nasal rod) for each picture to overcome the magnification.

### Cephalometric Landmarks, Planes, and Measurements (Fig. 1)

#### Cephalometric Landmarks

1. Point N (Nasion): The most anterior point on the nasofrontal suture in the median plane<sup>(22)</sup>.

2. Point S (Sella): The midpoint of the hypophysial fossa<sup>(22)</sup>.
3. Point Ar (Articulare): The point of intersection of the external dorsal contour of the mandibular condyle and the temporal bone<sup>(23)</sup>.
4. Point Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and inferior border of the mandible<sup>(24)</sup>.
5. Point Me (Menton): The lowest point on the symphyseal shadow of the mandible seen on a lateral cephalogram<sup>(24)</sup>.
6. Point A (Subspinale): The deepest midline point on the premaxilla between the anterior nasal spine and prosthion<sup>(25)</sup>.
7. Point B (Supramentale): The deepest midline point on the mandible between infradentale and pogonion.<sup>(25)</sup>
8. Point ANS (Anterior Nasal Spine): It is the tip of the bony anterior nasal spine in the median plane<sup>(22)</sup>.
9. Point PNS (Posterior Nasal Spine): This is a constructed radiological point, the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose. It marks the dorsal limit of the maxilla<sup>(22)</sup>.
10. Point Or (Orbitale): The lowest point on the inferior rim of the orbit<sup>(24)</sup>.
11. Point Po (Porion): The most superiorly positioned point of the external auditory meatus<sup>(24)</sup>.
8. Frankfort plane: A line passing through the points Porion and Orbitale<sup>(24)</sup>.
9. A line perpendicular to the mandibular plane, passing through point B<sup>(20)</sup>.

### **Cephalometric Measurements**

1. Actual symphysis: it is the portion of the mandible that lies anterior to a line perpendicular to the mandibular plane, passing through point B. This is measured parallel to the mandibular plane, from the most prominent point of the anterior border of bony symphysis<sup>(20)</sup>.
2. Effective symphysis: it is the portion of the mandible which lies anterior to a continuation of line NB, measured perpendicular to line NB from the most prominent point of the anterior border of bony symphysis<sup>(20)</sup>.
3. ANB angle: The angle between lines N-A and N-B. It is the most commonly used measurement for appraising sagittal disharmony of the jaws<sup>(21)</sup>.
4. SN-MP angle: The angle between the S-N plane and the mandibular plane<sup>(22)</sup>.
5. Frankfort - mandibular plane angle (FMA): That angle formed between the mandibular and Frankfort planes<sup>(26)</sup>.
6. PP-MP: The angle between palatal plane and mandibular plane<sup>(22)</sup>.
7. N-S-Ar: Saddle angle, between the anterior and the posterior cranial base. This angle formed at the point of intersection of the S-N plane and the S-Ar plane<sup>(22)</sup>.
8. S-Ar-Go: Articular angle, formed at the point of intersection of the S-Ar plane and the Ar-Go plane<sup>(22)</sup>.
9. Ar-Go-Me: Gonial angle, formed at the point of intersection of Ar-Go plane and the mandibular plane (Go-Me)<sup>(22)</sup>.
10. Sum of the posterior angles (Sum PA): The sum of saddle, articular, and gonial angles<sup>(22)</sup>.
11. N-Me: Total anterior facial height (AFH), the distance between nasion and menton<sup>(22)</sup>.
12. ANS-Me: Lower anterior facial height (LFH), the distance between anterior nasal spine and menton<sup>(22)</sup>.
13. S-Go: Posterior facial height (PFH), the distance between sellaturcica and gonion<sup>(22)</sup>.

### **Cephalometric Planes**

1. N-A line: Formed by a line joining nasion and point A<sup>(25)</sup>.
2. N-B line: Formed by a line joining nasion and point B<sup>(25)</sup>.
3. S-N plane: Formed by a line joining sellaturcica and nasion<sup>(22)</sup>.
4. S-Ar plane: Formed by a line joining sellaturcica and articulare<sup>(22)</sup>.
5. Ar-Go plane: Formed by a line joining articulare and gonion<sup>(22)</sup>.
6. Mandibular plane (MP): Formed by a line joining gonion and menton<sup>(22)</sup>.
7. Palatal plane (PP): Formed by a line joining anterior nasal spine and posterior nasal spine<sup>(22)</sup>.

14. S-Go/N-Me  $\times$  100: Jarabak ratio, represents the ratio of posterior facial height to anterior facial height multiplied by 100<sup>(22)</sup>.

### Statistical Analysis

The data were subjected to computerized statistical analysis using SPSS version 15 computer program. The statistical analyses included:

1. Descriptive Statistics: Mean, standard deviation (SD), minimum, and maximum values.
2. Inferential Statistics
  - Independent samples t-test: For comparison between both genders.
  - Pearson's correlation coefficient test: Performed to find out if any correlation is present between symphyseal measurements and mandibular rotation measurements.

### Result

Descriptive statistics and gender differences (independent samples t-test) were shown in table 1, in which we can notice that the actual and effective symphysis were not significantly differ between genders, while facial heights were significantly higher in males. Regarding the mandibular rotation angles, only SN-MP, saddle (N-S-Ar), and the sum of the posterior angles were significantly higher in females, while PP-MP, FMA, articular (S-Ar-Go), and gonial (Ar-Go-Me) angles showed non-significant higher mean values in males. Pearson's correlation coefficient test was used to clarify the correlation of the actual and effective symphysis with other variables (table 2). For both genders and the total sample, the actual symphysis didn't show any significant correlation with the facial heights and the mandibular rotation angles, on the contrary the effective symphysis showed in both genders and the total sample significant positive correlations with Jarabak ratio, and significant negative correlations with SN-MP, PP-MP, FMA, and the sum of the posterior angles. In males and the total samples, the saddle angle (N-S-Ar) significantly positively correlated with the

effective symphysis, while gonial angle (Ar-Go-Me) was significantly negatively correlated with it. Articular angle (S-Ar-Go) only significantly negatively correlated with the effective symphysis in the total sample.

### Discussion

A clear understanding of mandibular symphysis growth and morphology is very useful for orthodontic diagnosis and treatment planning<sup>(1)</sup>. Through the years, the orthodontist has become aware of the area of pogonion and its influence on esthetics. It has been stated that those who possess a good chin to begin with will continue to show an increase in the size area, both during and after treatment. Conversely, those who do not have the "strong" chin initially cannot be expected to attain a significant prominence subsequent to treatment. Thus, knowledge of both growth and treatment procedures becomes all the more important in understanding what is happening during the treatment process<sup>(3)</sup>. Previous Iraqi studies<sup>(27, 28)</sup> and other studies<sup>(1- 3, 9, 12, 16)</sup> that concerning with symphysis were concentrated on the morphology of the symphysis. This study was planned to assess the actual and effective symphysis and whether any correlations of them were found with the direction of mandibular rotation. Although the facial heights in this study were significantly higher in males than in females as usually found, there were no statistically significant differences in actual and effective symphysis between genders. SN-MP, FMA, and articular (S-Ar-Go) angles were within the normal ranges that described by Rakosi<sup>(22)</sup> and Tweed<sup>(26)</sup>, while PP-MP and gonial (Ar-Go-Me) angles showed slight decrease in their mean values compared to normal range (25° for the PP-MP angle and 128°  $\pm$  7° for the gonial angle)<sup>(22)</sup>, which is reflected by the decrease in the mean value of the sum of the posterior angles (less than 396°) and that mean a slight tendency toward horizontal growth pattern in this sample (table 1). Pearson's correlation test (table 2) revealed that the actual

symphysis did not show any significant correlation with the facial heights or mandibular rotation angles, while effective symphysis in both genders and the total sample showed significant negative correlations with SN-MP, PP-MP, FMA, and the sum of the posterior angles, and a significant positive correlation with Jarabak ratio. Effective symphysis significantly negatively correlated with the gonial angle in males and the total samples, and with the articular angle in the total sample only. All these results indicate that effective symphysis is closely correlated with angles of mandibular rotation and decreases as the angles increases. Although the effective symphysis did not show any significant correlation with the facial heights but the significant positive correlation with Jarabak ratio means that as the effective symphysis decreases the ratio of the anterior facial height increases. These relations of actual and effective symphysis with mandibular rotation may be attributed to that both points that constructing the line to which actual symphysis is measured were located within the

mandible making the actual symphysis is less responsive to the mandibular rotation, in contrast to the effective symphysis where the points that constructing the line to which it is measured were located on the cranium and the mandible so any rotation in the mandible will be easily detected in relation to this line. The positive significant correlations of the effective symphysis with the saddle angle in the males and the total samples means that as the mandible positioned posteriorly the effective symphysis increases, and since the increase in effective symphysis is associated with low mandibular rotation angles, that's mean when the condyle positioned backward there will be a compensatory forward rotation of the mandible.

### Conclusions

Effective symphysis is a good predictor of the direction of mandibular rotation due to its negative correlations with most of the mandibular rotation angles, while actual symphysis is a poor predictor.

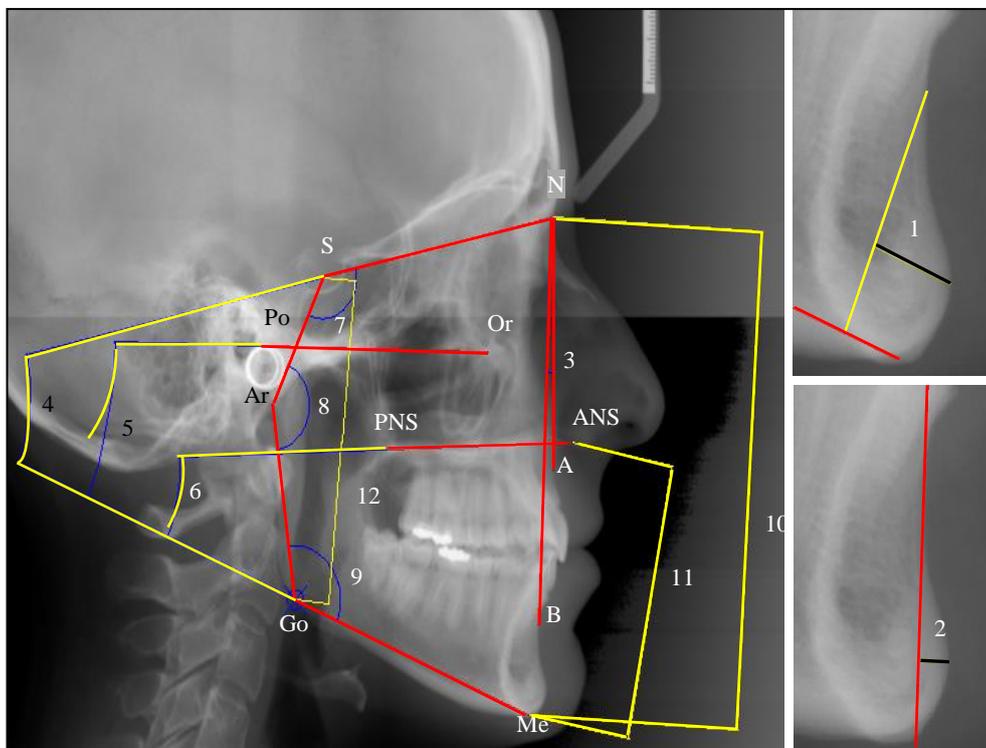


Fig.(1):-Cephalometric landmarks and measurements: N:nasion. S:sellaturcica. Ar:articulare. Go:gonion. Me:menton. A:subspinale. B:supramentale. ANS:anterior nasal spine. PNS:posterior nasal spine. Or:orbitale. Po: porion. 1:actual symphysis. 2: effective symphysis. 3: ANB angle. 4: SN-MP angle. 5: Frankfort mandibular plane angle. 6: PP-MP angle. 7: N-S-Ar (Saddle angle). 8:S-Ar-Go (Articular angle). 9:Ar-Go-Me (Gonial angle). 10: N-Me (AFH). 11: ANS-Me (LFH). 12: S-Go (PFH).

Table (1):- Descriptive statistics and gender differences.

Variables	Females (N=53)				Males (N=41)				Total (N=94)				Gender Differences (d.f.=92)	
	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	t	P
Actual Symphysis	2.66	8.74	5.87	1.58	3.37	11.22	6.37	1.41	2.66	11.22	6.09	1.52	-1.598	0.113
Effective Symphysis	-1.03	4.99	1.95	1.45	0.00	4.88	1.83	1.15	-1.03	4.99	1.90	1.32	0.441	0.660
AFH	97.09	118.76	111.21	4.36	106.81	139.12	121.71	6.48	97.09	139.12	115.79	7.49	-9.371	0.000***
LFH	50.50	69.04	62.15	3.98	59.07	86.80	69.94	5.53	50.50	86.80	65.55	6.09	-7.948	0.000***
PFH	64.52	87.45	73.65	4.22	74.92	93.19	83.77	4.79	64.52	93.19	78.06	6.73	-10.874	0.000***
JR	58.43	77.36	66.27	3.68	61.80	76.35	68.92	3.82	58.43	77.36	67.42	3.95	-3.402	0.001***
SN-MP	21.00	39.00	31.98	3.98	22.00	40.00	30.10	4.59	21.00	40.00	31.16	4.33	2.129	0.036*
PP-MP	11.00	34.00	22.75	4.39	13.00	34.00	22.88	4.90	11.00	34.00	22.81	4.59	-0.128	0.898
FMA	12.00	37.00	23.96	4.83	16.00	37.00	25.37	5.25	12.00	37.00	24.57	5.04	-1.346	0.182
N-S-Ar	114.00	137.00	126.53	5.44	110.00	134.00	122.98	5.04	110.00	137.00	124.98	5.53	3.242	0.002**
S-Ar-Go	126.00	156.00	142.21	6.13	129.00	157.00	142.88	6.18	126.00	157.00	142.50	6.13	-0.524	0.602
Ar-Go-Me	110.00	138.00	123.42	4.92	116.00	140.00	124.27	5.37	110.00	140.00	123.79	5.11	-0.802	0.425
Sum PA	381.00	399.00	392.15	4.03	382.00	400.00	390.12	4.62	381.00	400.00	391.27	4.39	2.273	0.025*

Table(2):- Pearson's correlation coefficient test for the symphyseal measurements and other variables.

Variables		Females (N=53)		Males (N=41)		Total (N=94)	
		Actual Symphysis	Effective Symphysis	Actual Symphysis	Effective Symphysis	Actual Symphysis	Effective Symphysis
AFH	r	-0.017	-0.168	0.196	-0.089	0.177	-0.121
	p	0.905	0.230	0.218	0.580	0.088	0.246
LFH	r	-0.042	-0.226	0.130	-0.220	0.136	-0.195
	p	0.766	0.103	0.418	0.167	0.191	0.060
PFH	r	-0.098	0.161	0.013	0.308	0.091	0.110
	p	0.484	0.249	0.935	0.050	0.382	0.293
JR	r	-0.101	0.283(*)	-0.182	0.397(*)	-0.070	0.290(**)
	p	0.473	0.040	0.256	0.010	0.505	0.005
SN-MP	r	0.050	-0.332(*)	0.127	-0.396(*)	0.045	-0.334(**)
	p	0.720	0.015	0.431	0.010	0.669	0.001
PP-MP	r	0.077	-0.297(*)	0.142	-0.379(*)	0.105	-0.326(**)
	p	0.584	0.031	0.375	0.014	0.312	0.001
FMA	r	-0.189	-0.426(**)	0.043	-0.457(**)	-0.065	-0.435(**)
	p	0.174	0.001	0.792	0.003	0.534	0.000
N-S-Ar	r	-0.102	0.174	0.123	0.504(**)	-0.066	0.292(**)
	p	0.469	0.212	0.443	0.001	0.528	0.004
S-Ar-Go	r	0.079	-0.212	-0.040	-0.292	0.039	-0.243(*)
	p	0.576	0.128	0.805	0.064	0.711	0.018
Ar-Go-Me	r	0.019	-0.209	0.014	-0.503(**)	0.030	-0.325(**)
	p	0.893	0.134	0.932	0.001	0.774	0.001
Sum PA	r	0.005	-0.342(*)	0.097	-0.425(**)	0.006	-0.349(**)
	p	0.969	0.012	0.545	0.006	0.955	0.001

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