

Reliability of the S-N line

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ABSTRACT

Aim: To evaluate the degree of the reliability of the S-N reference line by using highly stable reference lines (vertical and horizontal cranial axes). **Materials and Methods:** The sample of the study comprised of lateral cephalometric radiographs of patients 13-18 years, 12 males and 12 females for each of the three skeletal relationships. The ANB angles were 0-2, more than 2 and less than zero respectively. The method was conducted by localization of the anterior superior of anterior wall of sella turcica point (As), which is stable at age 5-6 years, drawing the Vertical Cranial Axis (VCA) which pass through the point As and tangent to the upper part of the anterior wall of the sella turcica (at least for 3 mm); then, drawing the Horizontal Cranial Axis (HCA), which is perpendicular to the VCA at the As point. The deflection and the sagittal dimension of the S-N line were measured to evaluate the variation in the location of the points S and N, which are the determinant of the S-N line. **Results:** Point N had significantly local variation between gender and among the three skeletal relationships, but that point S had insignificant local variation between gender and among the three skeletal relationships. **Conclusion:** The S-N line is not stable due to instability of the location of point N.

Key Words: Vertical cranial axis, Sella turcica, Frankfort horizontal plane.

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INTRODUCTION

Cephalometric analysis is considered the main aspect to determine the accurate diagnostic evaluation in orthodontics that involving a comparison of an individual cephalometric finding with norms for his/her ethnic group.

The majority of cephalometric measurements of the craniofacial parameters related to the relative stable line or lines. Many of the lateral cephalometric analyses referred the value of the parameters to the Frankfort Horizontal Plane (FH),⁽¹⁻³⁾ and other referred the value to the anterior cranial base plane (S-N plane).^(4,5) It was believed that the S-N plane is more reliable reference plane than FH plane.⁽⁵⁻⁷⁾

The S-N reference plane is affected by the growth pattern.⁽⁸⁾ The posterior wall and the floor of the sella turcica has continuous resorbing until 16-17 years of age. The center of sella turcica can not be regarded as stable until well after puberty.⁽⁹⁾ The anterior wall of sella turcica is stable by age 5-6 years of age.⁽⁹⁾

Because the values of cephalometric analysis are very vital in determining the normal skeletal and dental relations, thus

the reliability of the S-N reference plane gave great attentions to the researchers. Bishara *et al.*⁽¹⁰⁾ concluded that the relative variability of position of the points S and N are determinant factors in establishing the relative rotation of the S-N reference plane. This conclusion was matching the thought that the possible differences in recorded values of the angle SNA that could be partly ascribed the true variability in the antero-posterior location of the maxilla, whereas another part could be explained by the differences in the cranial base as represented by S-N plane.⁽¹¹⁻¹³⁾ Mills⁽¹⁴⁾ demonstrated that the significance of the ANB angle varies according to the size of the angles SNA and SNB, which in turn are affected by the length and cant of the S-N plane (the relative vertical and sagittal location of the N and S points).

This study was designed to evaluate the degree of the S-N plane deflection and its sagittal dimensions variation among the Classes I, II and III dental and skeletal relationships for both sexes.

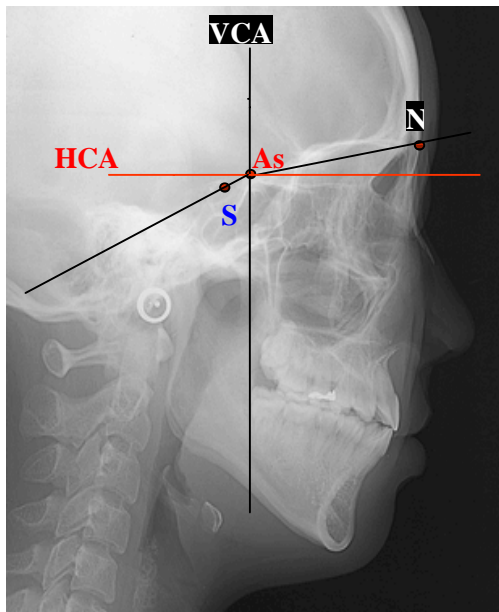
MATERIALS AND METHODS

The sample consisted of 72 lateral

cephalometric radiographs of Classes I, II and III dental and skeletal relationships for the patients who were attended Department of Pedodontics, Orthodontics and Preventive Dentistry, College of Dentistry, University of Mosul. The age of the patients was 13–18 years. The sample was grouped according to skeletal relationships depending on the ANB angle into Classes I, II and III. The ANB angle was 0–2 degree, more than 2 degree and less than 0 degree respectively. Each group was comprised of 12 lateral radiographs for each sex.

The methods were conducted (Figure 1) by:

1. Tracing the lateral cephalometric radiographs.
2. Localize the point As: The anterior superior point of the anterior wall of sella turcica (at the junction of the anterior wall of sella turcica with the anterior cranial baseline, which is stable at 5–6 years).⁽¹⁴⁾
3. Drawing the Vertical Cranial Axis (VCA) by drawing a line tangent to the point As and passing within the superior part of the anterior wall of sella turcica to avoid any discrepancy in the configuration of sella turcica inferiorly.



4. Drawing the Horizontal Cranial Axis (HCA) by drawing a perpendicular line to the VCA at the point As.

5. Evaluation the reliability of the S–N line was conducted by:

- I. Measuring the degree of the deflection of the S–N line. The deflection of the S–N line is mainly due to upward or downward location (vertical location) of the points N and/or S). The point of the antero–superior of the anterior wall of sella turcica is considered a stable point. Therefore, the S–N line deflection is partly or completely due to the deflection of the lines; N–As and/or S–As in relation to the HCA.
- II. Measuring the sagittal dimension of the S–N line. The sagittal dimension of S–N line is a result of the anterior or posterior location of the points N and S. To reveal the variation in location of these points, the point As was used (as stable point) as reference point to measure how far these points N and S away from the point As. These parameters were N–As and S–As distances.

Figure (1): The vertical and horizontal cranial axes

N: Nasion. S: Center of the Sella turcica Point. As: Anterior Superior Point of Anterior Wall of Sella Turcica.

VCA: Vertical Cranial Axis.

HCA: Horizontal Cranial Axis.

The data were analyzed by application of the following statistical analyses:

- 1) Descriptive analysis, including the mean, standard deviation, minimum and maximum values.

2) Student's t-test at $p \leq 0.05$ significant level for sex variation.

3) Duncan's Multiple Range Test at $p \leq 0.05$ significant level for skeletal groups variation.

RESULTS

The results of the deflection of the S-N line in relation to the HCA were categorized into:

1) Deflection; sex variation at $p \leq 0.05$ significant level of the lines N-As and S-As were represented in Table (1).

The N-As deflection showed significantly increase mean value in male than female for the three skeletal relationships. (Table 1).

The S-As deflection demonstrated insignificantly higher mean value in male than female for all the skeletal relationships.

2) Deflection; the skeletal variation (Classes I, II and III) at $p \leq 0.05$ significant level of the line; N-As and S-As were shown in Table (2).

The N-As deflection in male and female appeared significantly increase in mean value in Class III than Classes I and II. Skeletal relationships and Class I was greater mean value than Class II skeletal relationships. (Table 2 and Figure 2).

The S-As deflection in male and female revealed insignificantly higher mean value in Class III than Classes I and II. Skeletal relationship and Class I was insignificantly more mean value than Class II skeletal relationship (Table 2).

Table (1): Deflection, sex variation of the lines N-As and S-As

Skeletal Relation	Sex	Mean	± SD	Minimum Value	Maximum Value	t-value	Significance
N-As Deflection (in degrees)							
Class I	Male	13.76	3.11	10	19	3.84	Significant*
	Female	9.32	3.24	5	14		
Class II	Male	10.15	2.83	6	16	4.62	Significant*
	Female	7.24	3.45	3	13		
Class III	Male	21.80	4.61	10	36	4.26	Significant*
	Female	17.38	4.32	9	23		
S-As Deflection (in degrees)							
Class I	Male	32.13	4.62	22	42	1.23	Not Significant**
	Female	30.85	3.86	13	48		
Class II	Male	31.4	3.88	18	50	1.68	Not Significant**
	Female	29.63	4.21	12	45		
Class III	Male	35.53	4.35	30	51	1.26	Not Significant**
	Female	33.86	4.61	28	41		

SD: Standard deviation

*Significant ($p \leq 0.05$ level).

** Not significant ($p > 0.05$ level).

Table (2): Deflection, skeletal variation for the lines N-As and S-As in males and female

Skeletal Relation	Sex	N-As Deflection (in degrees)			S-As Deflection (in degrees)		
		Mean*	± SD	F-value	Mean*	± SD	F-value
Class I	Males	13.76 ^B	3.11	7.46	32.13 ^A	4.62	1.32
Class II		10.15 ^C	2.83		31.40 ^A	3.83	
Class III		21.38 ^A	4.61		35.53 ^A	4.35	
Class I	Females	9.32 ^b	3.24	7.32	30.85 ^a	3.86	1.41
Class II		7.24 ^c	3.45		29.63 ^a	4.21	
Class III		17.38 ^a	4.32		33.86 ^a	4.61	

*Means with different letters were statistically significant at $p \leq 0.05$ level.

SD: Standard deviation.

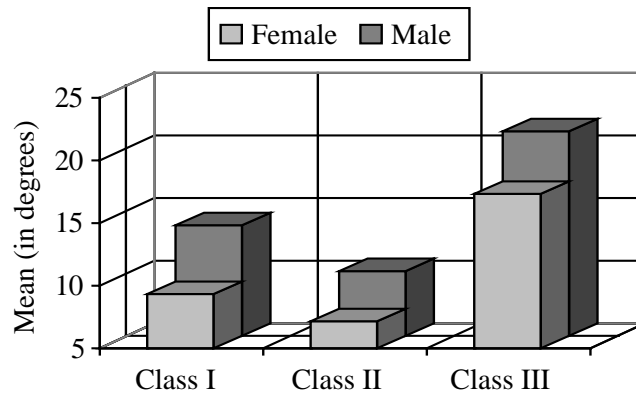


Figure (2): Mean of deflection, skeletal variation for the line N-As in males and females

The results of the sagittal dimension of the S-N line was categorized into:

- 1) The sagittal dimension; sex variation at $p \leq 0.05$ significant level of the lines; N-As and S-As (Table 3).

The N-As dimension showed significantly increase mean value in male than female in the three skeletal relationships. (Table 3)

The S-As dimension revealed insignificantly greater mean value in male than female in the three skeletal relationships.

- 2) The sagittal dimension; skeletal variation at $p \leq 0.05$ significant level of the lines;

N-As and S-As (Table 4).

The N-As dimension in male and female appeared significantly increase in mean value in Class II than Classes I and III skeletal relationships and Class I was significantly greater mean value than Class III skeletal relationship. (Table 4 and Figure 3)

The S-As dimension in male and female showed insignificantly greater mean value in Class II than Classes I and III skeletal relationships, and Class III was insignificantly higher mean value than Class I skeletal relationship. (Table 4)

Table (3): Sagittal dimension, sex variation of the lines N-As and S-As between sex

Skeletal Relation	Sex	Mean	± SD	Minimum Value	Maximum Value	t-value	Significance
N-As Dimension (in millimeters)							
Class I	Male	59.9	3.2	42.5	64.5	3.12	Significant*
	Female	54.6	3.4	38.5	62.5		
Class II	Male	65.3	3.8	52.5	79.5	3.24	Significant*
	Female	59.4	3.9	43.5	63.5		
Class III	Male	54.8	3.5	41.5	68.5	3.67	Significant*
	Female	42.5	3.6	38.5	64.5		
S-As Dimension (in millimeters)							
Class I	Male	5.3	1.8	2.5	8.5	0.46	Not Significant**
	Female	4.8	1.6	1.5	7.5		
Class II	Male	7.6	2.2	4.5	9.5	0.68	Not Significant**
	Female	6.8	2.5	2.5	9		
Class III	Male	5.8	2.3	2	7.5	0.39	Not Significant**
	Female	5.2	2.1	1.5	8		

SD: Standard deviation

*Significant ($p \leq 0.05$ level).

** Not significant ($p > 0.05$ level).

Table (4): Sagittal dimension, skeletal variation for the lines N–As and S–As among the three skeletal relations in males and female

Skeletal Relation	Sex	N–As Dimension (in millimeters)			S–As Dimension (in millimeters)		
		Mean*	± SD	F-value	Mean*	± SD	F-value
Class I	Males	59.9 ^B	3.2	7.28	5.3 ^{AB}	1.8	3.84
Class II		65.3 ^A	3.8		7.6 ^A	2.2	
Class III		54.8 ^C	3.5		5.8 ^A	2.3	
Class I	Females	54.6 ^b	3.4	6.83	4.8 ^a	1.6	1.62
Class II		59.4 ^a	3.9		6.8 ^a	2.4	
Class III		42.5 ^c	3.6		5.2 ^a	2.6	

*Means with different letters were statistically significant at $p \leq 0.05$ level.
SD: Standard deviation.

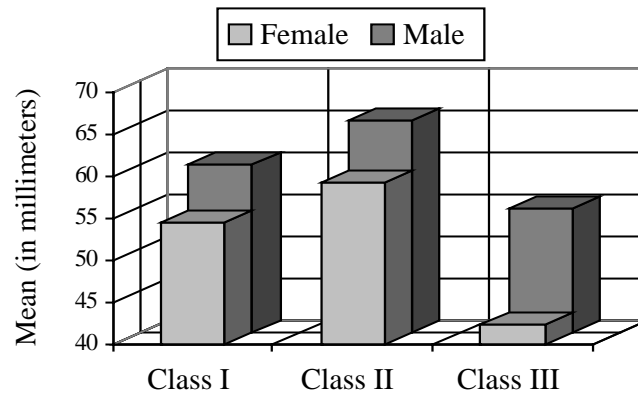


Figure (3): Mean of sagittal dimension, skeletal variation for the line N–As in males and females

DISCUSSION

The significantly high deflection of the N–As line in relation to the HCA was shown in male than female for the three skeletal relationships, could be due to generally increase of the craniofacial parameters in male than female. These came in accordance with the findings of other studies.^(15, 16) Sex variation could be due to that male grow at faster rate and for long period of time than female as concluded by other researchers.^(17, 18) Contrary to this conclusion, Kerr and Ford⁽¹⁹⁾ reported no sex difference in craniofacial parameters. While Graber⁽²⁰⁾ observed that the sex variation is strongly genetically determined.

The significant increase deflection (angle) in the N–As line in relation to the HCA was explored in Class III than Classes I and II skeletal relationships. This could be due to the difference in the growth pattern of these skeletal relationships, which cause more upward location of the point N. This came in accordance with the fi-

ndings of other studies.^(21–23)

The significant higher deflection of the N–As line in relation to the HCA was demonstrated in Class I than Class II skeletal relationship, indicating that the deflection of the N–As in Class I represents the average deflection of the compensatory growth pattern that compared with Classes II and III skeletal relationships. This was matched with the findings of other studies,^(24,25) which observed that the cranial base parameters affect the skeletal relationships.

The non significance in the deflection of the S–As line in relation to the HCA between male and female for the three skeletal relationships indicated that the point S has no statistically vertically location variation and do not significantly affected the S–N line. This result matched the suggestion of Johnson,⁽²⁶⁾ who reported that the central area of the tracing lateral skull radiographs appeared to be the least variable point. Mills⁽¹⁴⁾ stated that the significance

of the SNA angle and SNB, which in turn are affected by the length and cant of the S–N and the relative upward and downward location of the N point.

The non significant difference in the deflection of the S–As line in relation to the HCA among the three skeletal relationships declared that the point S has low vertical variation and has no statistical influence on the cant of the S–N line. This was similar to the suggestions of other studies,^(14, 26) which concluded that the central area (S) of the cranial base is the least local variation.

The significantly increase in the sagittal dimension of the N–As line in male than female for the three skeletal relationships could be explained generally by the fact that craniofacial parameters are greater in male than female as reported by other researchers.^(15, 27, 28)

The significantly greater sagittal dimension of the N–As line in Class II than Classes I and III skeletal relationships was obviously due to the large cranial base in Class II than in Classes I and III skeletal relationships, which affected the sagittal dimension of the S–N line. This was coordinated to the conclusions of other studies,^(19, 29–31) which found that the protruded maxilla associated with greater length of the sphenoid bone and the anterior cranial base.

The significant high mean value of the sagittal dimension of Class I than Class III skeletal relationship could be explained that the Class I skeletal relationship represent the average subject when compared with Classes II and III skeletal relationships.

The insignificant difference in sagittal dimension of the S–As line was appeared between male and female. This declared that point S is high stable point antero–posteriorly and has less statistical influence on the length of the S–N line. This result was matching to the conclusion of other studies.^(14, 26)

The insignificant difference of the mean values of the sagittal dimension of S–As line appeared among the three skeletal relationships could be explained obviously that point S has low antero–posterior local variation which does not affect the S–N line statistically. This came in coordi-

nation with other researchers,^(14, 26) who reported that point S is relatively high stable point.

CONCLUSIONS

The point N is not stable point among the three skeletal relationships for male and female, while the point S is relatively high stable point among the three skeletal relationships for male and female.

The line S–N is not reliable reference line, whereas the vertical and horizontal cranial axes are the alternative to apply in the cephalometric radiograph analysis.

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