

## ORIGINAL RESEARCH

### Effect of change in Position of Landmarks on Quantification of Sagittal Jaw Parameters: A Cross Sectional Study

Mir Mudasir Gul<sup>1</sup>, Sneh Kalgotra<sup>2</sup>, Rameez Hassan<sup>3</sup>, Abhishek Khajuria<sup>4</sup>

<sup>1,3,4</sup>Post- Graduate Student, <sup>2</sup>Registrar, Post Graduate Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College & Hospital, Srinagar, Jammu & Kashmir, India.

#### ABSTRACT:

It has been claimed that the ANB angle is affected by several environmental factors and thus a diagnosis based on this angle may give false results. By arbitrarily varying the position of points, lines and angles on cephalometric drawings, some authors have demonstrated geometrically that ANB angle can be changed, although the intermaxillary relationship were unchanged. So, the aim of the study was to evaluate effect of change in position of landmarks on quantification of sagittal jaw parameters. **Material and Methods:** There were total of 100 lateral cephalograms used for the study out of which 35 cephalograms were of male patients and 65 cephalograms were of female patients. Lateral cephalograms were taken from the pretreatment record files of the patients. The study sample was divided into 3 groups based on their skeletal relationship. **Results:** A 1.5° increase in angle ANB with every 4.0mm decrease in SN length and vice versa was observed. Each 5° increase in SN-OP caused 3.5mm decrease in value of Wits appraisal. Each 5.0° decrease in SN-OP resulted in a 3.5mm increase in value of Wits appraisal. Each 4.0° increase in SN-PP caused 3.0mm decrease in value of App-Bpp. Each 4.0° decrease in SN-PP resulted in a 3.0mm increase in value of App-Bpp. **Conclusion:** From the current study it can be concluded that, THE CHANGE OF Position of landmarks had a effect on the quantification of sagittal jaw parameters.

**Key words:** Cephalometrics, sagittal jaw parameters.

Received: 12 January 2017

Revised: 18 February 2017

Accepted: 20 February 2017

**Corresponding author:** Dr. Mir Mudasir Gul, Post- Graduate Student, Post Graduate Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College & Hospital, Srinagar, Jammu & Kashmir, India. India

**This article may be cited as:** Gul MM, Kalgotra S, Hassan R, Khajuria A. Effect of change in Position of Landmarks on Quantification of Sagittal Jaw Parameters: A Cross Sectional Study. Int J Res Health Allied Sci 2017; 3(2):44-50.

#### INTRODUCTION

One of the principal problems in orthodontic diagnosis has been the correct evaluation of the anteroposterior relationship of the maxilla and the mandible. Broadbent's introduction of cephalometer in 1931 started a new era in orthodontics in which a more detailed study of the relationship between teeth, jaws, face and head structure were deemed possible<sup>1</sup>.

One of the earliest methods to be introduced was AB plane angle by Downs in 1948<sup>2</sup>. A few years later, Riedel in 1952 introduced angles SNA, SNB and ANB<sup>3</sup>. The ANB angle has been recognized as a skeletal sagittal discrepancy indicator and has become the most commonly used measurement since that time. However many authors have identified shortcomings in ANB angle, notable among which are; Change in spatial position of the nasion, rotation of the jaws, rotation of the cranial base and the degree of facial prognathism.<sup>4,9</sup>

Jacobson in 1975, like many other authors, identified deficiencies in the ANB angle. Variations in the horizontal or vertical location of either nasion or sella can increase or decrease the ANB angle, without any change in the actual anteroposterior relationship of the jaws<sup>5</sup>.

It has been claimed that the ANB angle is affected by several environmental factors and thus a diagnosis based

on this angle may give false results. By arbitrarily varying the position of points, lines and angles on cephalometric drawings, some authors have demonstrated geometrically that ANB angle can be changed, although the intermaxillary relationship were unchanged.

#### MATERIALS AND METHODS:

The data collected for the study consisted of 100 pretreatment lateral cephalograms of patients who are undergoing or had already completed orthodontic treatment in the department of Orthodontics, govt. Dental college and hospital Srinagar. There were total of 100 lateral cephalograms used for the study out of which 35 cephalograms were of male patients and 65 cephalograms were of female patients. Lateral cephalograms were taken from the pretreatment record files of the patients. The study sample was divided into 3 groups based on their skeletal relationship.

Data from skeletal class II and skeletal class III patients was used to get an extreme variation of all the factors thought to affect the measurements under study. The following measurements were done on class II and class III subjects:

Table I	
1.	SN length
2.	N-A
3.	N-B
4.	SN-FH
5.	SN-OP
6.	SN-PP
7.	SNA
8.	SNB
9.	WITS
10.	ANB
11.	AF-BF

**Methodology** All the measurements of class I subjects were pooled up to draw an average cranium. The average cranium was then subjected to change in individual measurements till three standard deviations of the measurement and to the maximum and minimum value of the measurement obtained from class II and class III subjects if the value was not within three standard deviations. The changes in the affected measurement were then measured. Different diagrams showing change in sagittal parameters are given below (fig 4 to fig28):

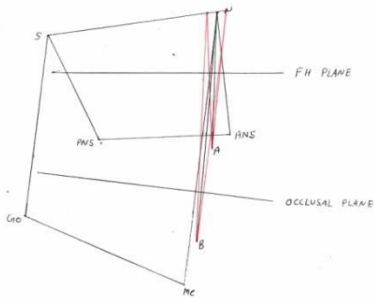


Fig. 1: Diagram showing effect of change in SN length ( $\pm 4\text{mm}$ ) on angle ANB

SN length (mm)	ANB (degree)
73.5	2
SN+4	0.5
SN-4	3.5

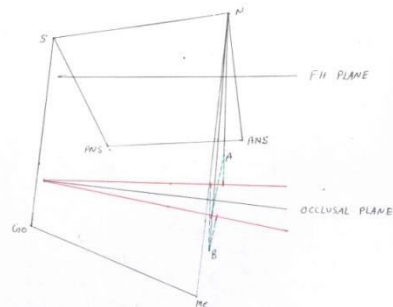


Fig. 2: Diagram showing effect of change in angle SN-OP ( $\pm 5\text{degree}$ ) on Wits analysis

SN-OP (Degree)	Wits value (mm)
15.0	2.0
SN-OP+5	-1.5
SN-OP-5	5.5

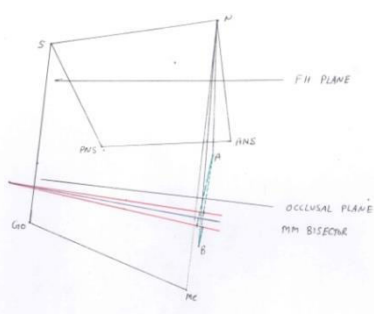
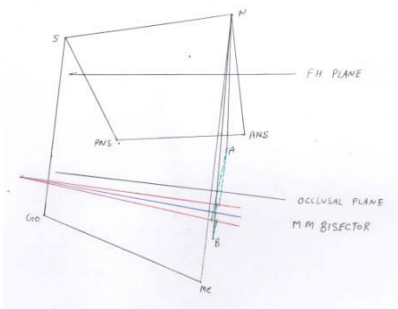


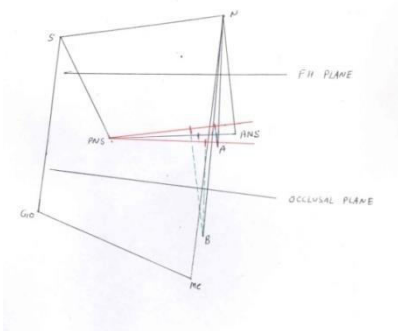
Fig. 3: Diagram showing effect of change in angle SN-MP ( $\pm 4\text{degree}$ ) on  $\text{MMB}^0$

SN-MP (Degree)	$\text{MMB}^0$ value (mm)
32.0	-0.5
SN-MP+4	-2.0
SN-MP-4	1.0



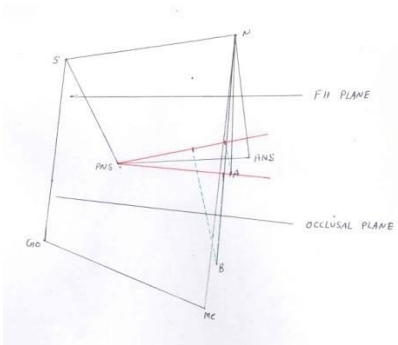
**Fig. 4: Diagram showing effect of change in angle SN-PP ( $\pm 4$ degree) on  $MMB^0$**

SN-PP (Degree)	$MMB^0$ value (mm)
8.0	-0.5
SN-PP+4	-2.0
SN-PP-4	1.0



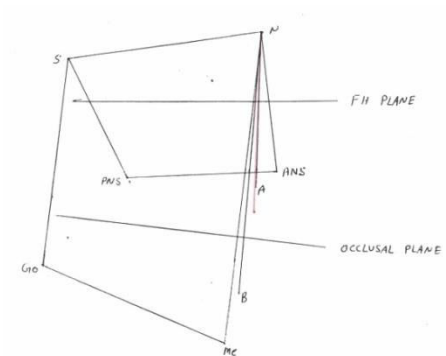
**Fig. 5: Diagram showing effect of change in angle SN-PP ( $\pm 4$ degree) on App-Bpp**

SN-PP (Degree)	App-Bpp (mm)
8.0	8.0
SN-PP+4	5.0
SN-PP-4	11.0



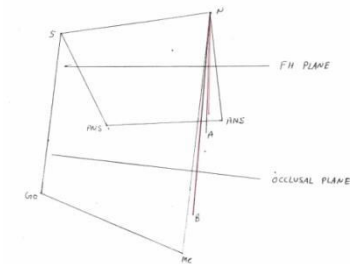
**Fig. 6: Diagram showing effect of change in angle SN-PP ( $\pm 8$ degree) on App-Bpp**

SN-PP (Degree)	App-Bpp (mm)
8.0	8.0
SN-PP+8	2.0
SN-PP-8	14.0



**Fig. 7: Diagram showing effect of change in NA distance (+9mm) on ANB**

NA distance (mm)	ANB (degree)
57.5	2.0
NA+9	0.5



**Fig. 8: Diagram showing effect of change in NA distance (-9mm) on ANB**

NA distance (mm)	ANB (degree)
57.5	2.0
NA-9	3.5

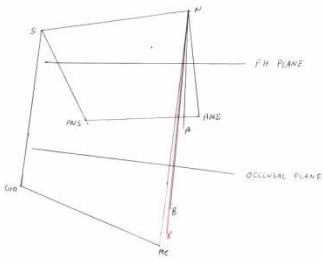


Fig. 9: Diagram showing effect of change in NB distance (+12mm) on ANB

NB distance (mm)	ANB (degree)
99.0	2.0
NB+12	3.0

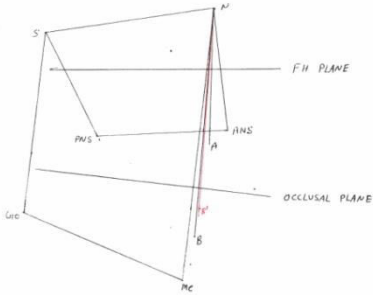


Fig. 10: Diagram showing effect of change in NB distance (-12mm) on ANB

NB distance (mm)	ANB (degree)
99.0	2.0
NB-12	1.0

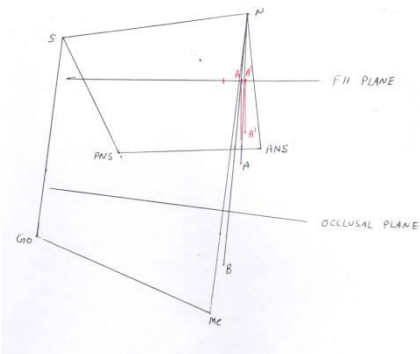


Fig. 11: Diagram showing effect of change in NA distance (-9mm) on AF-BF

NA distance (mm)	AF-BF (mm)
57.5	4.5
NA-9	6.0

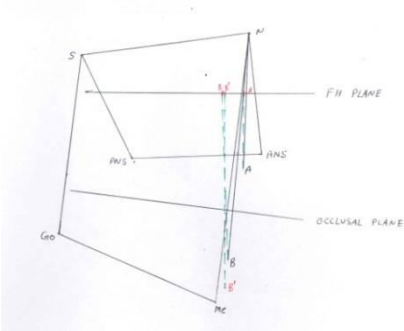


Fig. 12: Diagram showing effect of change in NB distance (+12mm) on AF-BF

NB distance (mm)	AF-BF (mm)
99.0	4.5
NB+12	3.5

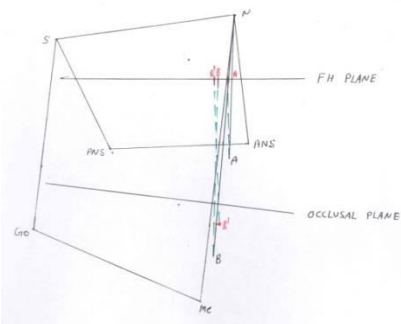


Fig. 13: Diagram showing effect of change in NB distance (-12mm) on AF-BF

NB distance (mm)	AF-BF (mm)
99.0	4.5
NB-12	5.5

**OBSERVATION AND RESULTS**

The results were calculated using SPSS software. The data from lateral cephalograms of Class I group was used to make an average cranium. The data from lateral cephalograms of class II and class III groups was used to obtain extreme value of variables supposed to affect different sagittal jaw parameters. The values of

different variables were then changed one by one in a stepwise fashion, from one standard deviation to three standard deviations for each group, on the average cranium to see their effect on different sagittal jaw parameters.

**Table II: Effect of change in SN length on angle ANB**

Mean SN length- 73.5±4.0mm Range- 64.5mm-82.0mm

SN length (mm)	ANB (Degree)
61.5	6.5
65.5	5.0
69.5	3.5
<b>73.5</b>	<b>2.0</b>
77.5	0.5
81.5	-2.0
85.5	-3.5

**Table III: Effect of change in NA distance on angle ANB**

Mean NA distance- 57.6±3.31mm Range- 50mm-66mm

NA distance (mm)	ANB (Degree)
48.5	3.5
51.5	3.0
54.5	2.5
<b>57.5</b>	<b>2.0</b>
60.5	1.5
63.5	1.0
66.5	0.5

**Table IV: Effect of change in NB distance on ANB**

Mean NB distance- 98.47±6.43mm Range- 85mm-115mm

NB distance (mm)	ANB (Degree)
81.0	0.5
87.0	1.0
93.0	1.5
<b>99.0</b>	<b>2.0</b>
105.0	2.5
111.0	3.0
117.0	3.5

**Table V: Effect of change in angle SN-OP on Wits analysis**

Mean SN-OP angle- 15.38±5.61° Range- 7°-26°

SN-OP (Degree)	Wits value (mm)
0	12.5
5.0	9.0
10.0	5.5
<b>15.0</b>	<b>2.0</b>
20.0	-1.5
25.0	-5.0
30.0	-8.5

**Table VI: Effect of change in angle SN-MP on MM Bisector**

Mean SN-MP angle-  $31.65 \pm 3.37^{\circ}$  Range-  $21.5^{\circ}$ - $47^{\circ}$

SN-MP (Degree)	MMB <sup>0</sup> value (mm)
20.0	4.0
24.0	2.5
28.0	1.0
<b>32.0</b>	<b>-0.5</b>
36.0	-2.0
40.0	-3.5
44.0	-5.0
47.0	-6.0

**Table VII: Effect of change in angle SN-PP on MMB<sup>0</sup>**

Mean SN-PP angle-  $8.11 \pm 4.04^{\circ}$  Range-  $0^{\circ}$ - $15^{\circ}$

SN-PP (Degree)	MMB <sup>0</sup> value (mm)
0.0	2.5
4.0	1.0
<b>8.0</b>	<b>-0.5</b>
12.0	-2.0
16.0	-3.5

**Table VIII: Effect of change in angle SN-PP on App-Bpp**

Mean SN-PP angle-  $8.11 \pm 4.04^{\circ}$  Range-  $0^{\circ}$ - $15^{\circ}$

SN-PP (Degree)	App-Bpp (mm)
0.0	14.0
4.0	11.0
<b>8.0</b>	<b>8.0</b>
12.0	5.0
16.0	2.0

**Table XVI: Effect of change in NA distance on AF-BF**

Mean NA distance-  $57.6 \pm 3.31$ mm Range- 50mm-65mm

NA distance (mm)	AF-BF (mm)
48.5	6.0
51.5	5.5
54.5	5.0
<b>57.5</b>	<b>4.5</b>
60.5	4.0
63.5	3.5
66.5	3.0

**Table XVII: Effect of change in NB distance on AF-BF**

Mean NB distance-  $98.47 \pm 6.43$ mm Range- 85mm-115mm

NB distance (mm)	AF-BF (mm)
81.0	6.0
87.0	5.5
93.0	5.0
<b>99.0</b>	<b>4.5</b>
105.0	4.0
111.0	3.5
117.0	3.0

## DISCUSSION

The ANB angle is the most commonly used measurement in evaluating the sagittal jaw discrepancy. Many factors have been reported to affect angle ANB. Horizontal position of nasion in relation to denture bases or point A has been said to affect angle ANB by many authors<sup>5,6,7,8</sup>. Vertical position of point A and point B has also been reported to affect angle ANB<sup>7</sup>. In the present study also, changes in position of point nasion resulted in change in angle ANB. Each 4mm increase in SN length resulted in 1.5° decrease in angle ANB. Each 4mm decrease in SN length resulted in 1.5° increase in angle ANB. The results of the study are in agreement with other studies reported in literature.

Wits analysis was proposed by Jacobson in 1975. Wits analysis has also been critically evaluated and reported to be affected by certain factors. Change in angle SN-OP has been proposed to affect Wits analysis. The present study has evaluated the change in Wits value with change in cant of occlusal plane i.e. angle SN-OP. The mean of angle SN-OP in the class I group was 15.38±5.61°. Freeman in 1981 showed that Wits appraisal can be affected by changes in cant of occlusal plane<sup>7</sup>. Similar findings have been seen in this study.

App-Bpp was introduced by Nanda and Merrill in 1994 for assessment of relative position of maxilla and mandible. Cant of palatal plane has been reported to affect App-Bpp measurement. This factor was evaluated in this study. Cant of palatal plane was studied in relation to SN plane. Mean SN-PP angle in class I group was found to be 8.11±4.04° with a range of 0°-15°. The results showed that each 4.0° increase in SN-PP caused 3.0mm decrease in value of App-Bpp value. Each 4.0° decrease in SN-PP resulted in a 3.0mm increase in value of App-Bpp value. Similar results were shown by Nanda and Merrill in their study<sup>10</sup>. They showed a 2mm change in App-Bpp value with 4° change in cant of palatal plane. In the present study, the change is slightly higher.

AF-BF measurement was introduced by Chang in 1987<sup>11</sup>. It can be affected by vertical position of point A and point B and by cant of FH plane. In the present study, each 3mm increase in NA distance resulted in 0.5mm decrease in AF-BF value. Each 3mm decrease in NA distance resulted in 0.5mm increase in AF-BF value. When studying effect of point B, it was found that each 6mm increase in NB distance resulted in 0.5mm decrease in AF-BF value. Each 6mm decrease in NB distance resulted in 0.5mm increase in AF-BF value. No study has seen the effects of change in position of point A or point B on AF-BF. Present study quantifies this effect.

## SUMMARY AND CONCLUSION

**The following conclusions were drawn from the present study:**

1. A 1.5° increase in angle ANB with every 4.0mm decrease in SN length and vice versa was observed.

2. A 0.5mm decrease in ANB value was seen with:
  - (I) Each 3mm increase in NA distance
  - (II) Each 6mm decrease in NB distance
3. A 0.5mm increase in ANB value was seen with:
  - (I) Each 3mm decrease in NA distance
  - (II) Each 6mm increase in NB distance
4. Each 5° increase in SN-OP caused 3.5mm decrease in value of Wits appraisal. Each 5.0° decrease in SN-OP resulted in a 3.5mm increase in value of Wits appraisal.
5. A 1.5mm decrease in value of MMB° was observed with:
  - (I) Each 4.0° increase in angle SN-MP
  - (II) Each 4.0° increase in angle SN-PP
6. A 1.5mm increase in MMB° value was observed with:
  - (I) Each 4.0° decrease in angle SN-MP
  - (II) Each 4.0° decrease in angle SN-PP
7. Each 4.0° increase in SN-PP caused 3.0mm decrease in value of App-Bpp. Each 4.0° decrease in SN-PP resulted in a 3.0mm increase in value of App-Bpp.
8. A 0.5mm decrease in AF-BF value was observed with:
  - (I) Each 3mm increase in NA distance
  - (II) Each 6mm increase in NB distance
9. A 0.5mm increase in AF-BF value was seen with:
  - (I) Each 3mm decrease in NA distance
  - (II) Each 6mm decrease in NB distance

## REFERENCES

1. Broadbent BH. A new x-ray technique and its application to orthodontia. *Angle Orthod* 1931; 1: 45-66.
2. Downs WB. Variations in facial relationships: their significance in treatment and prognosis. *Am J Orthod* 1948; 34: 812-840.
3. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. *Angle Orthod* 1952; 24: 140-145.
4. Taylor CM. Changes in the relationship of nasion, point A, and point B and the effect upon ANB. *Am J Orthod* 1969; 56: 143-163.
5. Jacobson A. The "Wits" appraisal of jaw disharmony. *Am J Orthod* 1975; 67: 125-138.
6. Ferrazzini G. Clinical evaluation of the ANB angle. *Am J Orthod* 1976; 69: 620-626.
7. Freeman RS. Adjusting A-N-B angles to reflect the effect of maxillary position. *Angle Orthod* 1981; 51: 162-171.
8. Hussels W, Nanda RS. Analysis of factors affecting angle ANB. *Am J Orthod* 1984; 85: 411-423.
9. Järvinen S. Floating norms for the ANB angle as guidance for clinical considerations. *Am J OrthodDentofacialOrthop* 1986; 90: 383-387.
10. Nanda RS, Merrill RM. Cephalometric assessment of sagittal relationship between maxilla and mandible. *Am J OrthodDentofacOrthop* 1994; 105: 328-44.
11. Chang HP. Assessment of anteroposterior jaw relationship. *Am J OrthodDentofacialOrthop* 1987; 92: 117-122.