

# Effect of deep overbite and curve of Spee on Wits appraisal with bisecting and functional occlusal planes

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## Abstract

**Introduction:** Various cephalometric analysis and their interpretations aid orthodontists in planning treatments. The aim of this study was to compare the differences in Wits appraisal with functional and bisecting occlusal planes in deep bite vs normal overbite and curve of Spee patients. In addition association of this difference with sagittal and vertical skeletal discrepancies was also assessed.

**Material and Methods:** 40 cephalograms each in deep and normal overbite cases were traced with Wits appraisal considering both functional and bisecting occlusal plane. The differences in Wits appraisal were assessed for any significant difference between deep and normal overbite groups and its correlations with curve of Spee, ANB, MMPA and other cephalometrics parameters were assessed.

**Results:** Group comparisons in Wits difference between deep and normal overbite yielded insignificant results ( $p=0.183$ ). However when data were analyzed between deep ( $>2\text{mm}$ ) and normal curve of Spee ( $<2\text{mm}$ ), significant differences emerged ( $p=0.002$ ). Only curve of Spee and overbite showed moderate ( $r=-0.421$ ) and weak ( $r=-0.249$ ) correlations with difference in Wits appraisals respectively.

**Conclusion:** Deep overbite alone does not seem to introduce major differences in the Wits appraisal with functional and bisecting occlusal planes. However in deep curve of Spee patients, this difference can be clinically significant.

**Keywords:** Cephalometry; Sagittal Jaw discrepancy; ANB

## Introduction

Diagnosis of antero-posterior jaw discrepancy is of vital importance in orthodontic treatment planning.<sup>1-3</sup> Lateral cephalometric radiographs are generally used for identification of such disharmony. In cephalometry, the sagittal relationship of the jaws has been traditionally been related to landmarks within the cranial base. ANB angle is one of the most common measurements to detect antero-posterior disharmony of the jaws. However, it has been debated that due to the rotations of the jaws and the changes in Nasion position, ANB can give errors regarding sagittal jaw relationships.<sup>1, 4-6</sup>

Jacobson promoted the use of "Wits" appraisal; a linear measurement of the sagittal jaw discrepancy based on perpendiculars from cephalometric points A and B drawn on the occlusal plane as an adjunct and/or alternative to the ANB angle.<sup>1, 7</sup> He advocated the use of functional occlusal plane for Wits appraisal however, bisecting occlusal plane has also been used for the same purpose.<sup>7</sup> Thayer found good correlation of Wits appraisal when drawn with functional and bisecting occlusal planes.<sup>8</sup>

It was soon realized however, that this measurement can also be distorted due to some factors notably cant of the occlusal plane and sagittal and vertical growth of jaws.<sup>8</sup> Since the perpendiculars from points A and B are drawn onto the occlusal plane, any change in its inclination is bound to present inconsistencies in Wits analysis.<sup>9, 10</sup> Thayer, despite finding good correlations with both occlusal planes warned that in mixed-dentition patients with deep bite, the bisecting occlusal plane may differ considerably from the functional occlusal

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plane of the deciduous and permanent molars.<sup>8</sup> Similarly, in mature dentitions, it may be difficult to follow the plane of maximum intercuspation in patients with a steep curve of Spee.<sup>3</sup>

It would be of interest to know how different Wits appraisal values with bisecting and functional occlusal planes would be in increased overbite and curve of Spee patients and how other occlusal and cephalometric characteristics relate to such differences. Hence the aim of this study was to compare the differences in Wits appraisal with functional and bisecting occlusal planes in deep bite vs normal overbite patients. In addition association of this difference with other malocclusion traits was also assessed.

## Material and Methods

This cross sectional study was conducted over a period of six months starting from July to Dec 2013. Departmental protocol at the Orthodontics Department, Sardar Begum Dental College provides for informed consent being taken at the time of taking initial diagnostic records. Ethical approval was obtained from Gandhara University Ethics Committee. Forty cephalograms of orthodontic patients and their dental casts each for deep and normal overbite group patients were selected from the records of the Sardar Begum Dental College (SBDC) patients. Cephalograms with fully erupted permanent dentition except third molars were included. Cases with evidence of craniofacial syndromes or tooth anomalies were excluded from the study.

All the radiographs were traced manually with an acetate paper attached to their surfaces. Tracing was carried out with a lead pencil in a dark room on a radiograph viewer. Landmark identification was carried out and cephalometric planes were traced on each radiograph (Fig 1). The cephalometric and dental cast measurements are listed in (Table I).

**Table I: List of Measurements**

<b>Cephalometric Measurements</b>
SNA angle
SNB angle
ANB Angle
SN-MP Angle
PP-MP angle
Wits Appraisal F
Wits Appraisal B
<b>Dental Cast Measurements</b>
Overbite
Curve of Spee

On dental casts, cases with 1-3 mm overbite were classified as normal while deep bite cases had overbites of 4 mm or more. Similarly cases with 1-2 mm were classified as normal curve of Spee and more than 2mm were classified as deep curve of Spee.

Twenty tracings and dental cast measurements were repeated again with a minimum of one month between each measurement to check for intra-observer reliability of the measurements.

All statistical calculations were carried out with the SPSS software Version 11 (Chicago, Ill). Independent sample t-test was used to evaluate statistical significance for comparing mean values between corresponding data sets i.e. Wits difference with functional and bisecting occlusal plane in deep vs normal overbite and curve of Spee patients. Statistical significance was set at  $P < 0.05$ . Pearson's correlation coefficients were used to find any positive or negative association among the variables.

## Results

Out of 80 study participants, 52 (65%) were females and 28 (35%) were males. Mean overbite in normal bite cases was 2.41 mm (0.79 SD) and in deep bite cases it was 5.05 mm (0.86 SD). Means and standard

**Table II: Descriptive statistics**

Variables	Normal Bite		Deep Bite		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Age	17.18	4.67	17.73	4.53	17.45	4.58
SNA	81.25	3.44	81.74	3.90	81.49	3.66
SNB	78.30	3.01	77.74	4.54	78.02	3.84
ANB	3.05	2.54	4.00	2.23	3.53	2.42
SNMP	32.55	5.52	29.78	5.77	31.16	5.78
PPMP	25.20	6.14	23.20	6.11	24.20	6.17
COS	1.95	1.10	2.74	0.93	2.34	1.08
Wits-F	-0.49	3.56	2.20	3.42	0.86	3.72
Wits-B	0.70	3.18	3.89	3.01	2.29	3.47
Overbite	2.41	0.79	5.05	0.86	3.73	1.56
D-Wits	-1.19	1.70	-1.69	1.62	-1.44	1.67

**Table III. Correlations**

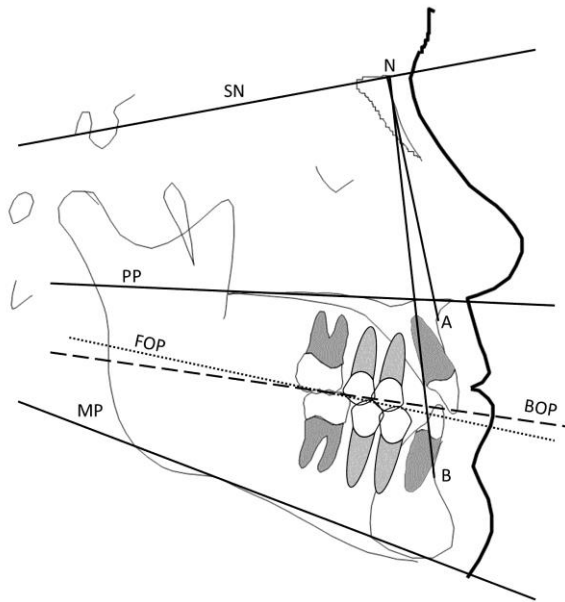
		AGE	SNA	SNB	ANB	SNMP	PPMP	COS	WITS-F	WITS-B	OB	D-WITS
WITS-F	r value	-0.02	0.04	-0.37	0.65	-0.16	-0.26	0.19	1.00	0.89	0.39	0.37
	p	0.86	0.70	0.00	0.00	0.15	0.02	0.09	.	0.00	0.00	0.00
WITS-B	r value	0.05	-0.01	-0.39	0.61	-0.18	-0.28	0.41	0.89	1.00	0.54	-0.09
	p	0.67	0.93	0.00	0.00	0.12	0.01	0.00	0.00	.	0.00	0.45
D-WITS	r value	-0.15	0.12	-0.01	0.18	0.00	0.01	-0.42	0.37	-0.09	-0.25	1.00
	p	0.20	0.30	0.96	0.11	0.97	0.93	0.00	0.00	0.45	0.03	.
WITS-F: Wits Appraisal with Functional Occlusal Plane												
WITS-B: Wits Appraisal with Bisecting occlusal plane												
D-WITS: Wits F - Wits B												

**Table IV. Group comparisons of Wits & Curve of Spee in deep & normal overbite**

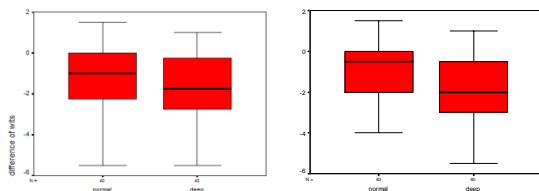
Independent Samples Test				
	Mean Difference	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	Upper
D-Wits (Overbite Normal vs Deep)	0.5000	0.183	-0.24027	1.24027
D-Wits (Curve of Spee Normal vs Deep)	1.1250	0.002	0.42045	1.82955

deviations for all variables tested are shown in (Table II). No significant differences were found among variables in both groups. Moderate to weak negative correlations were found among difference in Wits appraisal, curve of Spee and overbite. (Table III) The rest of the variables did not show any significant correlations.

Group comparisons in Wits difference between deep and normal overbite yielded insignificant results ( $p = 0.183$ ). However when data were analyzed between deep ( $>2\text{mm}$ ) and normal curve ( $<2\text{mm}$ ) of Spee, significant differences in Wits appraisals emerged ( $p=0.002$ ). (Table IV) and (Figure 2)



**Figure 1: Cephalometric Landmarks and Planes: A: Point A (Sub-spinale), B: Point B (Supra-Mentale), SN: Sella Nasion plane, MP: Mandibular Plane, PP: Palatal Plane, FOP: Functional occlusal plane, BOP: Bisecting occlusal plane**



**Figure 2: Box plots showing difference of Wits in both groups**

## Discussion

This study evaluated the difference in Wits appraisal with functional and bisecting occlusal planes in deep and normal bite cases. The same difference was assessed when the groups were re arranged for deep and normal curve of Spee.

Wits appraisal has received a mixed response from the orthodontic fraternity ever since it's popularization by Jacobson in 1975 and has been a subject of debate among experts in cephalometrics. Some studies reported good correlation between Wits and ANB angle and

thus took Wits appraisal as a good estimate of antero-posterior jaw discrepancy.<sup>8,11</sup> However, others found poor relationship and reported errors in predicting one from the other.<sup>3, 9, 12</sup>

One of the major drawbacks identified was the dependence on the occlusal plane. Hence this study intended to identify such difference when different occlusal planes, i.e. functional and bisecting occlusal planes are used. Thayer studied the difference in Wits appraisal with functional and occlusal planes in 35 males and statistically related both the functional and bisecting Wits appraisals to two dental parameters (overjet and incisor angulation) and one skeletal parameter (angle ANB). He found high correlations with these parameters with either method. He concluded that either occlusal plane could be used in estimation of Wits appraisal.<sup>8</sup> His study however did not address the deep bite and curve of Spee. Clinical observations suggest that in patients with deep bite and increased curve of Spee, the functional occlusal plane may differ considerably from the bisecting occlusal plane, hence our decision to stratify our sample with regard to these two parameters.<sup>10, 13</sup>

Like previous several reports the correlation of Wits appraisal with both types of occlusal planes was good with sagittal skeletal cephalometric angle ANB( $r>0.60$ ).<sup>4, 6, 11, 14</sup> The difference of Wits appraisal with both occlusal planes was not correlated with vertical skeletal cephalometric parameters i.e. SN-MP and PP-MP.

Similarly curve of Spee and overbite demonstrated moderate ( $r= -0.421$ ) and weak ( $r=-0.249$ ) negative correlation with difference of Wits with either occlusal plane respectively. Both of these correlations were significant ( $p<0.05$ ). This is in agreement with Oktay who observed that occlusal plane inclinations can easily be changed by vertical movements of incisors and molars or both which can lead to deep bite and/or increased curve of Spee in the lower arch.<sup>4</sup>

However, when difference in deep vs normal bite was evaluated, it was insignificant (0.500 mm,  $p=0.183$ ). Given the high ranges of difference in Wits appraisal, it can be inferred that mere presence of deep bite does not introduce major difference in the use of functional or bisecting Wits, unless it changes the inclination of the occlusal plane.

One such factor which can change the inclination of the occlusal plane is the depth of curve of Spee in the lower arch. When the sample was re-distributed in deep vs normal curve of Spee, significant differences were found (1.125 mm,  $p=0.002$ ). This would imply that in deep curve of Spee patients, the difference in occlusal plane inclination can be pronounced and one must exercise caution when interpreting Wits appraisal in such cases.

How much of difference is clinically significant when it comes to Wits appraisal? Clearly, difference of 1-2mm in values does not seem to be of much diagnostic significance but it must be borne in mind that there is a narrow range for normal Wits appraisal so 2 different values with different occlusal planes 2 mm apart can change the diagnostic opinion of the unwary. Given that in both deep and normal overbite groups demonstrated a huge range of difference (5.5mm), it must be emphasized that there may be other factors at play affecting this difference than just the variables we included in study. This is in concordance with Nanda et al who tested the effect of growth on Wits appraisal and found that even mild changes in the angulation of occlusal plane can bring about major changes in Wits appraisal.<sup>3,9</sup> Hence they suggested that Wits appraisal should be interpreted in combination with other cephalometric methods of assessment of sagittal discrepancies keeping in mind the effects of changes in its component parts.

## Conclusions

Significant differences were observed in the Wits appraisal with both occlusal planes in deep vs normal curve of Spee. Deep and

normal bite cases did not demonstrate a significant difference however. Both curve of Spee and overbite showed moderate correlations with difference in Wits appraisals.

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