

Comparative Study Between Wits Appraisal and I Line

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A comparison of the diagnostic implications of the *Wits* appraisal and *I line* values, finding complementary information

KEY WORDS: • CEPHALOMETRICS • I LINE • WITS APPRAISAL •

Orthodontists are frequently involved in the identification of maxillary and mandibular disharmony in their patients, and often use cephalometric analyses based on patterns which are considered to be normal among American youths, but sometimes not among Brazilian teenagers.

The methods developed by TWEED (1946) and STEINER (1953) are utilized mainly because of their academic usage, which undeniably contributes to the development of judgment and acquisition of mathematically described clinical objectives.

INTERLANDI (1971) suggests a graphic reference from which it is possible to check the position of the mandibular incisors in relation to the maxilla and the mandible. This morphodifferential approach, named *I line* analysis by Interlandi, does not propose established numerical patterns. Through this method it is possible to relate the upper and lower jaws according to the individual anatomic characteristics, and determine a numerical evaluation of incisor position and treatment plan.

The *Wits* appraisal (JACOBSON 1975, 1976) is another cephalometric diagnostic aid which enables us to measure the severity of an anteroposterior jaw disharmony. It complements any other cephalometric analysis.

Use of the *I line* is intended to determine an "ideal" position of the mandibular incisors in relation to the maxilla and to the mandible. On the other hand, the

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Wits appraisal applies a linear dimension to the harmony of the apical bases without the interference of those factors that may modify the amplitude of the A-N-B angle (RIEDEL 1952).

Employment of these two methods in combination can offer an increased contribution to the morphologic description of anomalies of the maxillomandibular complex, and despite the individual limitations of each method, their use together contributes to an objective diagnosis. Since the eugathic or dysgnathic origin of a studied anomaly is characterized by the specialist, it will be easier to have a correct cephalometric vision of the positions of the lower incisors and their relation to the craniofacial structures.

This cross-sectional mixed cephalometric study relates the measurements obtained by the use of the *I line* and the **Wits** appraisal from Brazilian-born teenagers who had not received orthodontic treatment.

— Materials and Methods —

The study sample consisted of 51 boys and 53 girls between 11 and 18 years of age. Planes, landmarks and cephalometric lines were drawn on the anatomical tracings of each of the 104 cephalometric tracings. The linear dimensions were measured with a caliper calibrated in 0.1mm units, and angles were measured with a protractor calibrated at 0.5° intervals.

Points used in this analysis are S, N, A, B, P' (located at the intersection of N-A line with P line that represents the nasal floor), and E (indicated by a perpendicular from the mandibular plane to the most forward point of the mandibular symphysis). Points AO and BO are obtained through the orthogonal projection of points A and B onto the occlusal plane (Fig. 1). The occlusal plane is traced as a tangent line from the occlusal

surface of the last lower molar in occlusion to the incisal edge of the mandibular central incisor.

The **Wits** appraisal is expressed as the linear distance on the occlusal plane between points AO and BO in millimeters. When point BO is located more forward than AO, the measured distance is expressed as a negative value.

The *I line* is drawn as a segment of straight line crossing the occlusal plane and connecting points P' and E (Fig. 2).

Discrepancies are measured in millimeters from the *I line* to the incisal edge of the mandibular central incisor. If the *I line* and the incisal edge coincide, the discrepancy is zero. A negative (−) incisor discrepancy is represented by a forward position of the incisor in relation to the *I line*. If the tooth is lingual to the *I line*, the measurement is considered to be positive (+).

— Results —

Table 1 shows the mean values of *I line* and **Wits** appraisal measurements and their respective standard deviations. This shows a slight difference for *I line* in the female sample, which is confirmed in the **Wits** values.

For analytical study, the samples were divided into groups according to *I line* mean values, which indicate dentoalveolar discrepancy, and those mean values obtained from the **Wits** appraisal by which the apical base relation can be evaluated (Table 2). Values between −2.5mm and +2.5mm are considered to be normal for *I line*. The normal range for the **Wits** appraisal is considered to be between −2.0mm and +4.0mm for males and between −4.5mm and +1.5mm for females.

Group 1 was composed of patients who were considered to have an excellent apical relation and little or no incisor discrepancy. The *I line* mean for males was

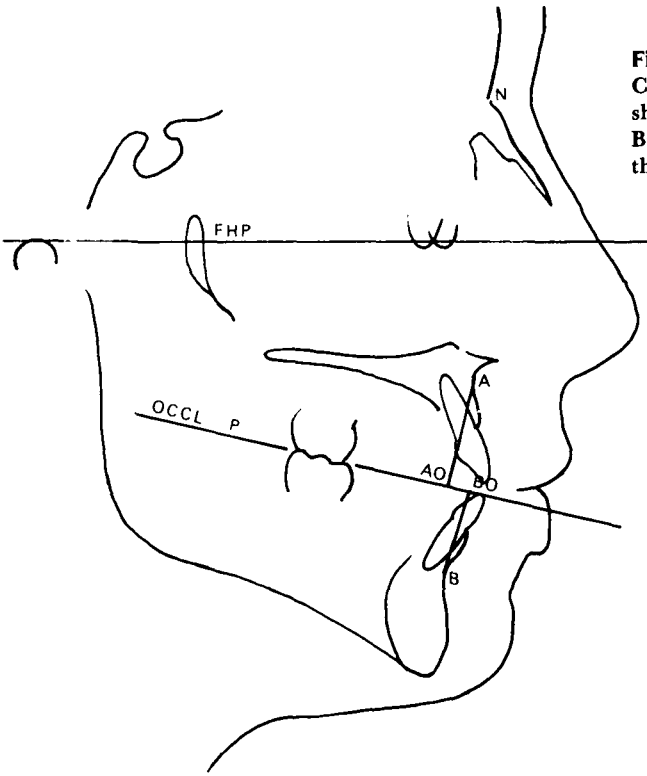


Fig. 1
Cephalometric tracing showing points AO and BO, which are used in the *Wits* appraisal

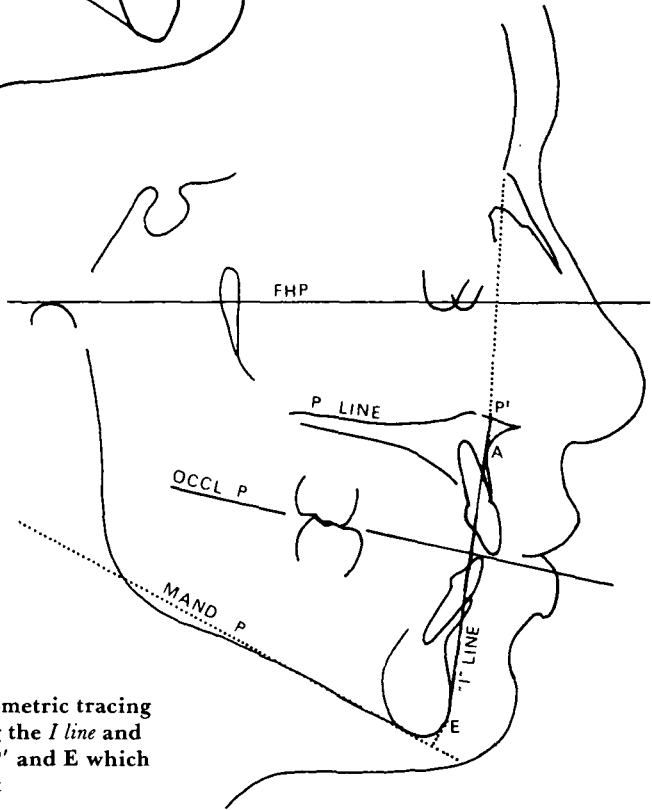


Fig. 2
Cephalometric tracing showing the *I line* and points P' and E which define it

-1.13mm and -0.75mm for females. These results may demonstrate the slight preponderance of a maxillary protrusion among the male sample. This group represents 16% from the whole mixed sample of patients in this study.

Group 2, representing almost 20% of the whole sample of patients, displayed maxillary protrusion elements (positive *Wits* appraisal values) without considerable incisor discrepancy (*I line*=0 ± 2.5mm). *I line* means were -0.50mm ♂ and -0.70mm ♀, and *Wits* appraisal means +7.09mm ♂ and +5.18mm ♀.

Group 3, representing only 7.5% of the sample, was selected from persons who had a preponderance of mandibular protrusion (negative *Wits* appraisal values) and no significant incisor discrepancy. In comparing males and females according to the *Wits* appraisal it will be noted that the female mean is significantly lower (-8.53mm vs. -3.92mm) in this small group of patients.

Group 4, the largest subgroup of the studied population (30%), consists of those with good apical relation and a negative *I line* value exceeding -2.5mm, which is suggestive of dental protrusion. Actual means for the *I line* were -4.59mm ♂ and -4.96mm ♀. The average *Wits* appraisal values of +1.41mm ♂

and -0.82mm ♀ were also representative of mandibular protrusion.

Group 5, with normal apical relations and positive incisor discrepancy (retrusion) consisted of one female subject with *Wits* appraisal and *I line* values of 4.50mm and 1.60mm, respectively.

Group 6 was composed of persons who lacked apical base harmony, with the distance between AO and BO exceeding JACOBSON'S (1975) tolerance limits. Dental protrusion was indicated by negative *I line* values exceeding -2.5mm. There was a preponderance of females, represented by 16 subjects against only 5 males. The mandibular protrusion among the females was clearly demonstrated by the mean *Wits* values of -1.92mm ♀ and 0.62mm ♂.

Group 7, only 2 males, was composed of those with deficient apical base relations and positive incisor discrepancies (dental retrusion).

— Discussion —

If we apply JACOBSON'S (1975) patterns of normality and INTERLANDI'S (1971) means to this study sample, we find 11 males (21.5%) and 6 females (11.3%) fitting into the limits of both ranges of normality.

Table I

<i>I line</i> and <i>Wits</i> appraisal						
Mean values, standard deviations, and Student's t test						
(Millimeters)						
	Mean	Males SD	t	Mean	Females SD	t
<i>I line</i>	-2.29	±2.76	-6.02*	-3.03	±2.56	-8.65*
<i>Wits</i> appraisal	+2.16	±4.34	-1.93*	-0.18	±5.21	-2.36*

*t test significant at p < .005

Table 2

Distribution of Subjects in Groups
According to Tooth–Apical base relation and Incisor discrepancy

Males						
Apical base relationship Incisor discrepancy	N	%	<i>I line</i>		<i>Wits</i>	
			Mean	S.D.	Mean	S.D.
1 Apical bases good No Incisor Discrep.	11	21.5	-1.13	±1.14	+0.19	±1.16
2 Maxillary Protr. No Incisor Discrep.	12	23.5	-0.50	±1.06	+7.09	±2.44
3 Mandibular protr. No Incisor Discrep.	5	9.8	-1.10	±0.66	-3.92	±1.31
4 Apical bases good (-) Incisor Discrep.	16	31.3	-4.59	±1.26	+1.41	±1.61
5 Apical bases good (+) Incisor Discrep.	-	-	-	-	-	-
6 Poor Apical Relat. (-) Incisor Discrep.	5	9.8	-5.90	±1.80	+0.62	±6.27
7 Poor Apical Relat. (+) Incisor Discrep.	2	3.9	+5.00	±1.00	+8.55	±2.05
Total	51	100				

Females						
Apical base relationship Incisor discrepancy	N	%	<i>I line</i>		<i>Wits</i>	
			Mean	S.D.	Mean	S.D.
1 Apical bases good No Incisor Discrep.	6	11.3	-0.75	±1.21	-0.78	±1.72
2 Maxillary Protr. No Incisor Discrep.	12	22.6	-0.70	±1.49	+5.18	±2.19
3 Mandibular protr. No Incisor Discrep.	3	5.6	-2.00	±0.40	-8.53	±2.35
4 Apical bases good (-) Incisor Discrep.	15	28.3	-4.96	±1.69	-0.82	±1.72
5 Apical bases good (+) Incisor Discrep.	1	1.8	+4.50	-	+1.60	-
6 Poor Apical Relat. (-) Incisor Discrep.	16	30.1	-4.50	±1.17	-1.92	±6.55
7 Poor Apical Relat. (+) Incisor Discrep.	-	-	-	-	-	-
Total	53	100				

Some extreme cases showed absence of incisor discrepancy (*I line*=0) while the *Wits* appraisal showed a severe magnitude of maxillary protrusion. These clearly demonstrate that the anatomical structures may vary independently.

Cephalometric methods are based on a series of points and lines and their relations among themselves. These form a measurable sequence and harmony in such a way that if you consider only a single point the final numeric value may be incorrect, incomplete or misleading. The didactic division used to study the craniofacial segments promotes a sum of these segments in such a way that consecutive addition of mistakes may be avoided.

In a general way, it can be said that the male individuals presented a maxillary protrusion while the females presented a slight mandibular protrusion. In the complete studied sample, almost half had a good relation between the apical bases while the other half showed some variation.

A cephalometric appraisal of the dental relations of the 104 subjects demonstrates that most of the results are indicative of dental protrusion; almost 40% of the male sample and 60% of the females had mean *I line* values about -5.00mm .

According to the suggestion of several authors this characteristic can be reflected on the facial profile. HAUSSER (1956) states that the integumental profile of the face changes according to the subjacent bony structures, and PECK AND PECK (1970) say that "beautiful faces have good skeletal supports". However, SUBTELNY (1959) assures that the soft tissue of the facial structures are not essentially related to the underlying skeletal structures.

For a better understanding of the relationship of the underlying skeletal structures and the profile, we tried some comparisons that may give a more objective vision of the problem.

In the present study we found 17 patients whose values are indicative of a good apical base relation and little or no incisor discrepancy. These represent 16.3% of the total. Two examples are Fig.3, a male whose H.NB angle (HOLDWAY AND MERRIFIELD 1966) was 12.5° (norm 9° to 12°), and Fig. 4, a female with an H.NB angle of 9.5° .

An opposite example can be seen in Fig. 5, which shows a severe apical disharmony and accentuated incisor discrepancy (*Wits* appraisal 9.0mm and *I line* 7.5mm). These measurements together show a very pronounced protrusion of the lower jaw; the H.NB angle is 4.0° and the illustration shows a poor profile.

Fig. 6 shows a female with a marked convex profile, *Wits* appraisal 5.2mm , *I line* -6.0mm , and H.NB angle 20.5° .

— Summary and Conclusions —

By using a sample of 104 young people of both sexes, 17 of them with a good relation of tooth apical base and little or no incisor discrepancy, the authors tried to establish a possible relationship between the *Wits* appraisal and the *I line* and to examine the several correlations among selected groups.

The authors find that the values obtained through the two methods together might give a rapid view of the cephalometric condition of the patient with regard to the relationship of the apical structures and discrepancy in the lower incisor relation to the maxillomandibular complex.

Based on the findings, the following conclusions might be drawn:

- Nearly 16% of the sample had a good apical relation and little or no incisor discrepancy

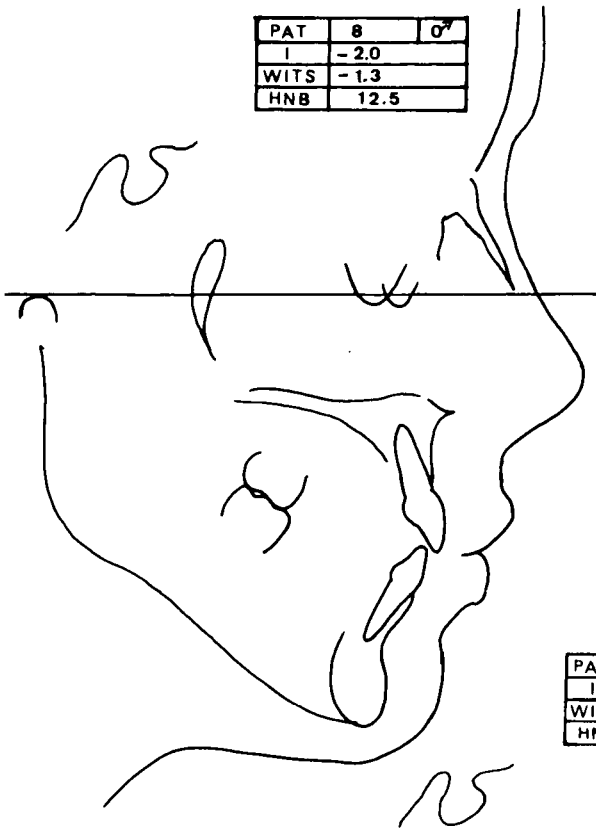


Fig. 3
 A male patient with *I* line and *Wits* appraisal values within the normal limits established by Interlandi and Jacobson. The soft tissue profile is harmonious.

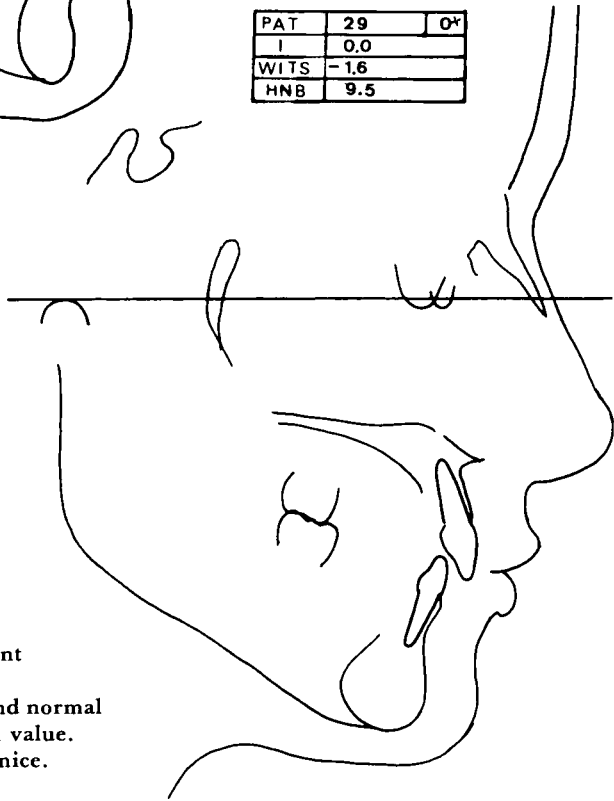
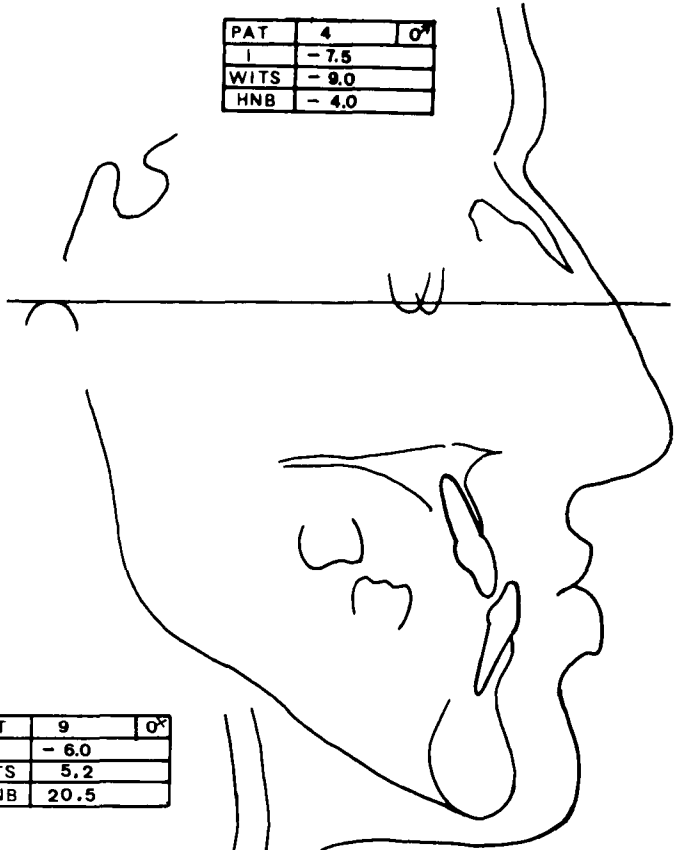


Fig. 4
 A female patient without *I* line discrepancy and normal *Wits* appraisal value. The profile is nice.

Fig. 5
 A male patient with *I* line and *Wits* appraisal measurements indicative of excessive dental protrusion and mandibular dental discrepancy. The profile is characteristic of a severe Angle Class III malocclusion.

PAT	4	0°
I	- 7.5	
WITS	- 9.0	
HNB	- 4.0	



PAT	9	0°
I	- 6.0	
WITS	5.2	
HNB	20.5	

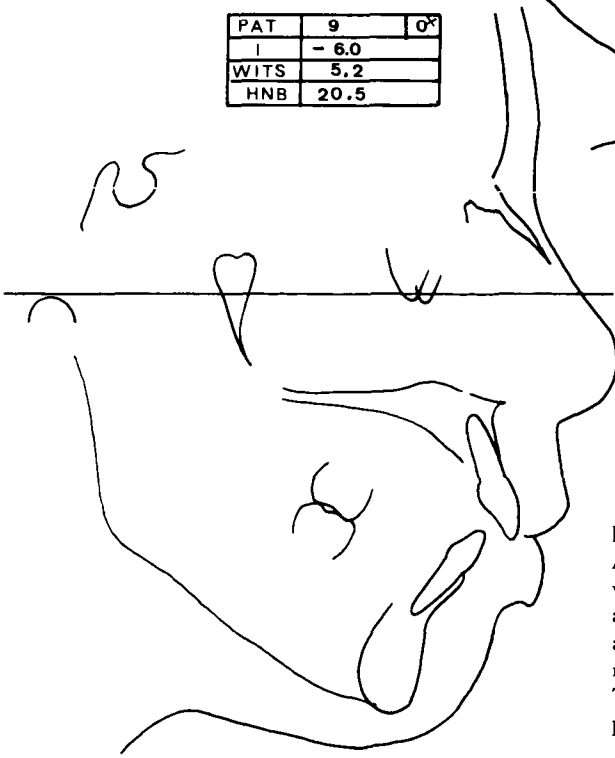


Fig. 6
 A female patient whose values for *I* line and *Wits* appraisal indicate an accentuated dental and maxillary protrusion. The profile shows pronounced convexity.

- The majority of the male population was represented by individuals with a good relation of apical bases and negative discrepancy (dental protrusion)
- The majority of the female sample was represented by patients with deficient apical relation (slight mandibular protrusion) and negative incisor discrepancy (dental protrusion).

The simultaneous usage of *Wits* appraisal and *I line* evaluation can offer

a simple way to get an objective and rapid vision of the maxillomandibular relation and the incisor discrepancy. But only a meticulous complete clinical and cephalometric examination can establish the critical elements that compose a diagnosis, considering the aetiopathogenesis of the anomalies of the patient and the related data, to proceed with the execution of the correct therapy to be applied in orthodontic treatment. A/O

REFERENCES

- Hausser, E. 1956. The profile of the soft and hard tissues of the face in correct occlusion. *Dent. Abstr.* 1:198-199.
- Holdaway, R.A. 1966. The profile line as an aid in critically evaluating facial esthetics. *Am. J. Orthod.* 52:804-822.
- Interlandi, S. 1971. Linha I na análise morfo-diferencial para o diagnóstico ortodôntico. *Rev. Fac. Odont. USP (São Paulo)* 9:289-310.
- Jacobson, A.
1975. The Wits appraisal of jaw disharmony. *Am. J. Orthod.* 67:125-138.
1976. Application of the Wits appraisal. *Am. J. Orthod.* 70:179-189.
- Peck, H. and Peck, S. 1970. A concept of facial esthetics. *Angle Orthod.* 40:284-318.
- Riedel, R. A. 1952. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. *Angle Orthod.* 22:140-145.
- Steiner, C. C. 1953. Cephalometrics for you and me. *Am. J. Orthod.* 39:729-755.
- Subtelny, J. D. 1959. A longitudinal study of soft tissue facial structures and their profile characteristics defined in relation to underlying skeletal structures. *Am. J. Orthod.* 45:481-507.
- Tweed, C. H. 1946. The Frankfort mandibular plane angle in orthodontic diagnosis, classification, treatment planning and prognosis. *Am. J. Orthod.* 32:175-230.