OVERVIEW

Differences in Skeletal Class II Diagnosis Using Various Cephalometric Analyses

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(Editor's Note: In this quarterly column, JCO provides an overview of a clinical topic of interest to orthodontists. Contributions and suggestions for future subjects are welcome.)

Cephalometric analysis plays an important role in orthodontic diagnosis and treatment; over the past half-century, increasingly comprehensive and accurate cephalometric systems have been developed. Overreliance on cephalometric data, however, can be problematic if different systems yield different diagnostic results. The present study compared the Steiner, Ricketts, and Cervera analyses, which are based on different reference planes, in the skeletal diagnosis of 35 patients with Class II malocclusions.

The Steiner system, introduced in 1950, can be considered the first modern cephalometric analysis, because it takes into account not only the measurements themselves, but also their relationships to one another. Steiner's reference plane is the anterior cranial base (sella-nasion plane), in the upper third of the face.[1-3] In 1960, Ricketts introduced a system that allowed morphological evaluation and individual growth forecasting of the craniofacial complex by means of a Visualized Treatment Objective (VTO). His reference plane is Frankfort horizontal (porion-orbitale plane), in the middle third of the face.[4-7] In 1970, Cervera, echoing Tweed's emphasis on function, moved


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cephalometric analysis away from an anthropometric-anthropologic concept of orthodontic pathology toward a gnathologic concept based on the morphology and function of the stomatognathic apparatus. Cervera's reference is the occlusal plane of the dental arches.[8] Thus, the Steiner system relates the upper third of the craniofacial complex to the lower third, the Ricketts system relates the middle third to the lower third, and the Cervera system uses landmarks only from the lower third of the face.

Materials and Methods

This study involved 35 male and female patients, age 7 to 13, who had not undergone previous orthodontic treatment. All patients had been identified at their screening visits as having Class II malocclusions according to the Angle classification; each had an overjet of more than 4mm.

Lateral cephalograms were taken on all patients in centric occlusion and natural head position, using the same machine.[9,10] The radiographs were scanned and analyzed with OrisCeph* software. All cephalometric tracings and diagnoses of skeletal malocclusion were made by the same person. Only landmarks that could be used to classify a skeletal malocclusion were noted for this study. If a landmark identification was difficult, a second observer was asked for assistance. In cases of disagreement, a third observer was consulted, and the landmark was finalized after the agreement of two observers.

Each of the three analyses under consideration (Figs. 1-3) was traced on each patient radiograph. A skeletal diagnosis was then made for each analysis on the basis of the amount of deviation from the norm, with differences of more than one standard deviation (S.D.) considered valid. Subjects with abnormal vertical growth patterns, as evidenced by a Ricketts facial axis of more than 1 S.D. from the norm of 90° ± 3°, were excluded from the study.

Mean values and standard deviations for the three cephalometric systems were calculated using SPSS version 11.0.** Because the three systems use different measurements, it was not possible to perform a traditional statistical analysis comparing the three groups; rather, only the final diagnoses indicated by the analyses were compared.

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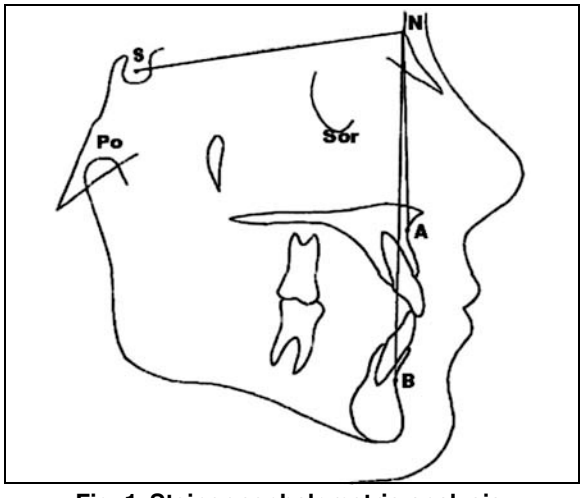

Fig. 1 Steiner cephalometric analysis.

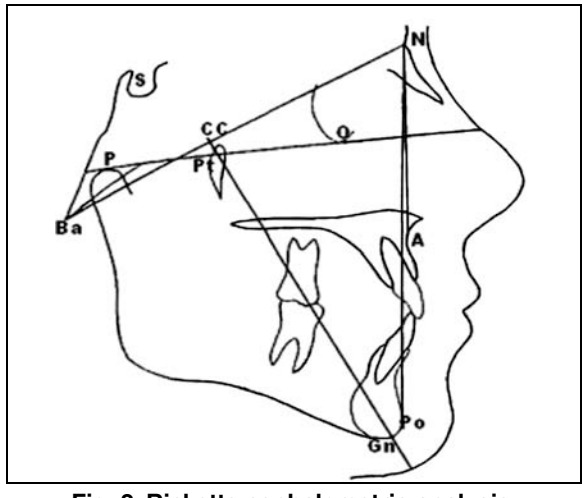

Fig. 2 Ricketts cephalometric analysis.

TABLE 1
MEAN CEPHALOMETRIC DATA AND DIFFERENCES FROM NORMS

	Mean	S.D.	Norm	Mean Difference	No. of S.D.
Steiner System					
SNA	82.90°	4.49°	82°±2°	0.90°	0.45
SNB	76.83°	3.17°	80°±2°	3.17°	1.58
ANB	6.08°	8.57°	2°±2°	4.08°	2.04
Ricketts System					
Facial plane	87.78°	4.06°	89°±3°	1.22°	0.40
Facial convexity	3.26mm	1.48mm	2mm±2mm	1.26mm	0.63
Maxillary depth	92.66°	4.16°	90°±3°	2.66°	0.88
Cervera System					
A-Vertical	2.62mm	1.01mm	1mm±1mm	1.62mm	1.62
Po-Vertical	3.60mm	2.16mm	1mm±1mm	2.60mm	1.30
A+Po*	6.44mm	2.62mm	2mm±2mm	4.44mm	2.22

*Sum of A-Vertical and Po-Vertical.

Results

Overall, the mean skeletal values that were more than 1 S.D. from the norm (Table 1) were SNB (Steiner), ANB (Steiner), A-Vertical (Cervera), Po-Vertical (Cervera), and A+Po (Cervera). The other mean values were within a normal range of 1 S.D.: SNA (Steiner), facial plane (Ricketts), facial convexity (Ricketts), and maxillary depth (Ricketts).

According to the Steiner analysis, the average patient in the study had a skeletal Class II malocclusion, with cephalometric values indicating mandibular retrusion. According to the Ricketts analysis, the average case was a borderline Class I with maxillary protrusion and mandibular retrusion. According to the Cervera analysis, the average patient had a skeletal Class II malocclusion due to maxillary protrusion and severe mandibular retrusion.

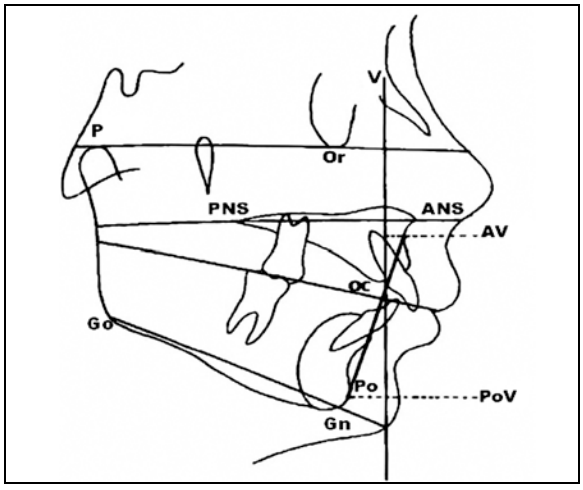

Fig. 3 Cervera cephalometric analysis.

It is important to note that in the Ricketts system, normal facial convexity decreases by 1mm every three years, from 5.5mm at age 3-6 to 2mm at the end of growth. In addition, the facial plane value increases by .33° every year from age 9 to the end of growth. The subjects included in this study ranged in age from 7 to 13.

Discussion

These results show that diagnoses of skeletal malocclusion can differ according to the particular cephalometric analysis used. Our findings are consistent with those of Wylie and colleagues, whose evaluation of 10 patients under five different cephalometric systems showed only 40% diagnostic agreement. They concluded that cephalometric analysis should not be the sole diagnostic determinant, especially in patients with dentofacial deformities.[11] Krogman and Sassouni, in a 1957 study of Class II cases using 44 different cephalometric analyses, some of which are still familiar (Downs,

Steiner, Tweed, Northwestern, Bjork, Coben), found highly variable results, such as diagnosing the same case as mandibular protrusion, maxillary protrusion, or orthognathic, depending on the reference plane used.[12] Al-Balkhi even questioned the relevance of cephalometric standards, stating that good orthodontic results can be produced without achieving normal values.[13]

Opinions vary concerning the accuracy and reproducibility of digital cephalometric measurements. Some authors have claimed that conventional manual tracing is more accurate,[14-16] while others have found no difference between the two methods.[17,18] The literature also indicates a high degree of variability in identification of cephalometric landmarks by different clinicians, due to differences in experience and the difficulty of landmark localization.[19] Accuracy is certain to improve with advances in three-dimensional technology.[20,21] In the present study, however, all the cephalometric tracings were performed in the same way and by the same operator to ensure reproducibility and consistency.

Conclusion

The aim of modern cephalometric analysis is to evaluate the relationships among skeletal and dental units with respect to standard horizontal and vertical planes. This study confirms, however, that data obtained from cephalometric tracings must be complemented by clinical evaluation.[22] Treatment of a malocclusion diagnosed solely on the basis of cephalometric values will not necessarily improve facial esthetics and, in fact, can actually create esthetic problems. Cephalometric analysis is only one tool; it should be used along with the clinical examination, model analysis, growth study, and facial analysis to arrive at an accurate diagnosis and an appropriate treatment plan.

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