Reliability of Soft Tissue Profile Analysis in Children

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Two similar evaluation panels consisting of Orthodontists, Pedodontists and Dental students evaluated soft tissue profiles of children 8 and 12 years old. Categorization of the underlying skeletal pattern from that information was poor, indicating a need for more complete information such as radiographs for an adequate diagnosis of skeletal aberrations in this critical age period.

The assessment of a patient's facial profile is a common diagnostic procedure. Facial profile analysis is widely taught and used as a means for evaluating the morphology of both soft tissue and the underlying skeletal structures.

The profile can be a critical factor in diagnosis and treatment planning, since the relationships between skeletal structures and between incisors and lips are often major treatment goals. The profile can be the first indicator in the identification of skeletal discrepancies and the need for referral for dentofacial evaluation. Accurate recognition of a skeletal problem in the mixed dentition can be especially important.

LITERATURE REVIEW

In the 4th century B.C., the Greeks described the "golden mean" as a mathematical ratio applicable to good

esthetics of any object, including the face. Our modern facial form analysis is similar to that used by Leonardo DaVinci in the fifteenth century to evaluate facial harmony and balance in his drawings and sculptures.

The importance placed on the facial profile in orthodontic diagnosis and treatment planning is illustrated by the Ackerman and Proffit diagnostic scheme,[1] in which the profile is accorded status equal to other major problems.

Many investigations have been conducted to define a desirable "ideal" for males and females. Lines et al.[2] evaluated facial esthetics in silhouettes and related the choices of the raters to their training in facial esthetics.

In a longitudinal study, Subtelny[3] showed that the soft tissue components reflect the underlying skeletal structures, although some parts of the soft tissue profile do not precisely follow the skeletal contour.

Cheney[4] considered the balance of the dentofacial structures to be a crucial factor in early treatment. He used a perpendicular from nasion to the Frankfort horizontal to study the anteroposterior balance of facial relationships. Moyers[5] popularized this method of Proffit and Norton,[6] modified by plotting only the soft tissue landmarks relative to the reference lines.

Fields and Vann[7] demonstrated that the Proffit and Norton method was not reliable for assessing skeletal and dental relationships in young children, probably due to the variability of the thickness and distribution of the soft tissue drape in that age group.

Objectives

Since routine cephalometric radiography for screening purposes is not justified, some other reliable method of initial clinical evaluation would be highly desirable.

The purpose of this study was to establish the reliability of a visual assessment of the facial profile and to determine its effectiveness for children 8 and 12 years old. The recognition of skeletal discrepancies in these age groups is especially critical where facial orthopedic correction during the active growing period may provide the most effective therapy.

In addition to the age of the children, the effects of training and experience of the observers and use of a facial photograph were also evaluated.

Materials and Methods

Subjects were 40 children, 20 age 8(±.5) years and 20 age 12(±.5) years. All incisors were erupted in all subjects.

TABLE 1

Balanced Factorial Design of the Study.

	20 Pedodontists	*20 Orthodontists*	*20 Students*
20 Photographs & Tracings 10 8 yrs old 10 12 yrs old	10 Pedodontists made 20 assessments	10 Orthodontists made 20 assessments	10 students made 20 assessments
20 Tracings 10 8 yrs old 10 12 yrs old	10 Pedodontists made 20 assessments	10 Orthodontists made 20 assessments	10 students made 20 assessments

Raters were 20 orthodontists, 20 pedodontists and 20 senior dental students. The orthodontists and pedodontists were selected to reflect a variety of training, years in practice and geographic location, with 30 engaged in private practice and 10 primarily in education with some intramural practice. The students were randomly selected from a class of 83 senior dental students.

Each of the three categories of raters was randomly divided into two groups of 10 that were then merged into two working groups consisting of 10 orthodontists, 10 pedodontists and 10 dental students (Table 1).

Both groups were asked to make their determinations from tracings of the soft tissue profile outline from cephalometric radiographs, supplemented for group two by lateral facial photographs (Fig. 1). Each group evaluated ten subjects from the 8-year-old sample and ten from the 12-year-old sample.

Each rater was asked to independently classify each child into one of three skeletal categories: orthognathic (normal), retrognathic (convex), or prognathic (concave). They were told that the three skeletal categories were not necessarily equally represented.

Correctness of the experimentally rated classifications was determined by the authors on the basis of the A-N-B angle in the Bolton standards. In the 8-year-old sample, an A-N-B angle within one standard deviation (1.5°) of the Bolton mean of 3.5° was categorized as orthognathic, 5° or more as retrognathic, and 2° or less as prognathic. The Bolton mean of 3.1° +/−1.7° was used for the 12-year-old sample.

Skeletal relationships were further evaluated by assessing each patient with Harvold's[9] values for the age-related maxillary and mandibular unit differences, and each child was categorized consistently under both standards.

The ranking data were analyzed further to ascertain the reliability (reproducibility) of the raters' judgments by asking the 20 dental students to evaluate the profiles a second time three months later. The test-retest ratings were assessed with a weighted Kappa analysis, which permitted assessment of agreement above the chance level. This also made differential weighting of disagreements possible,[10-13] since confusion of retrognathic and prognathic would be worse than rating either as orthognathic.

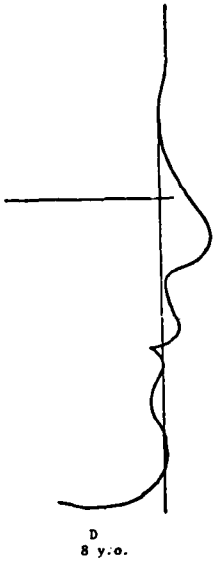
Differences between age groups were evaluated with a matched pairs t-test. Differences in rater training and diagnostic materials used were evaluated with a two-way analysis of variance. The percentage of correct judgments by the raters for each skeletal classification (orthognathic, retrognathic, prognathic) was also determined.

Results

The weighted Kappa analysis demonstrated values between 0.4 and 1.0 for the test-retest measure of reliability. The largest p-value was 0.01, indicating that it was highly unlikely that similar judgments were the result of chance.

The mean number of correct judgments are reported in Table 2. The raters were able to assess the skeletal patterns of 12-year-olds with only fair success (68% correct). Rating of the 8-year-olds was no better than chance, with an average of only 42% correct.

These findings were unaffected by supplementing the profile tracing with photographs. Application of a two-way analysis of variance to compare performance of raters on the basis of professional education (orthodontist, pedodontist, dental student) showed



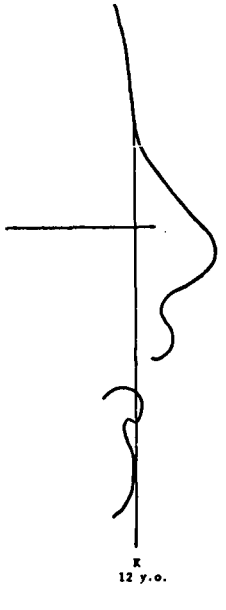


Fig. 1 Typical photographs and soft tissue outline tracings evaluated by group 2. Group 1 used only the tracings.

TABLE 2

Analysis of Number of Correct Assessments of Facial Profiles*

Pt. Age	*Diagnostic Material*	*Raters*			
		Student	*Pedodontist*	*Orthodontist*	*All*
		Mean(S.E.)	Mean(S.E.)	Mean(S.E.)	Mean(S.E.)
8 yrs.					
	Tracing	4.3(.40)	4.2(.39)	3.7(.30)	4.1(.21)
	Tracing & Photo	4.7(.37)	4.2(.29)	4.0(.54)	4.3(.24)
	All	4.5(.27)	4.2(.24)	3.9(.30)	4.2(.16)
12 yrs.					
	Tracing	6.5(.43)	7.1(.35)	6.7(.33)	6.8(.21)
	Tracing & Photo	6.8(.36)	7.0(.21)	6.5(.40)	6.8(.19)
	All	6.7(.27)	7.1(.20)	6.6(.26)	6.8(.14)

* No. Correct Based on 10 Assessments

no significant differences among the different rater categories.

The mean percentage of patients in each skeletal classification that were correctly assessed is shown in Table 3. In the 8-year-old group the retrognathic patients were judged most consistently (77%), with only 24% of the orthognathic and 28% of the prognathic patients correctly identified. Both orthognathic and retrognathic patients were judged with greater accuracy in the 12-year-olds. Prognathism was poorly recognized in both groups.

Discussion

The reliability (consistency) of the raters' scoring was very high, showing that careless judgment was not a factor. Unfortunately, care and consistency are not enough to assure that such scoring is correct, because a rater can very reliably and consistently record the name incorrect judgments.

In this study, approximately 3.5 correct judgments out of 10 could be attributed to chance. All raters were near this level of accuracy in their assessment of 8-year-old children. This is the optimum age for referral of

TABLE 3

Mean Percentage of Correct Assessments for Each Skeletal Class.

	Orthognathic	*Retrognathic*	*Prognathic*
	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)
Age 8	24 (19.9)	77 (26.4)	28 (22.4)
Age 12	80 (5.1)	92 (4.9)	22 (26.4)

many skeletal problems to the orthodontist for possible early treatment, so it is discouraging that evaluation of this age group without cephalometric radiographs was so poor.

All rater groups were much more accurate in their ability to assess the 12-year-old patients, which may be one reason for the higher frequency of referral at that age.

One might argue that the assessment of skeletal status without dental information is unrealistic. In a study by LaVelle,[14] the addition of dental information to cephalometric profile analysis did significantly increase the number of correct evaluations, but use of another possibly dependent variable is not a valid consideration. Evaluation of facial form should stand alone.

There are several possible explanations for the general lack of ability to accurately classify skeletal pattern on the basis of the overlying soft tissue. Two that were reviewed by the authors and found to be unimportant in this study were variations in lip posture (Hillesund[15]) and compensatory head posture.

It is of special interest to us that the prognathic patients were not well recognized in either age group. From inspection of the subjects, it appeared that the raters may have focussed on the chin rather than on the relation between maxilla and chin. Those prognathic patients who were assessed with least accuracy were those in whom maxillary deficiency was a major contributor to their prognathic relationship.

Later evaluation by the authors showed that those who exhibited some degree of vertical discrepancy were also often assessed incorrectly. Even though there is a relationship between vertical and anteroposterior discrepancies, their interaction may not always be identified when using a classification based only on horizontal relationships.

This study emphasizes the importance of careful and adequate clinical assessment, especially in the younger age groups and those where vertical discrepancies may be a factor. Visual assessment may be used in initial screening, but a failure rate ranging from 20% to over 60% makes it clear that important decisions require supporting radiographs for a definitive diagnosis.

Conclusions

Soft tissue outlines from profile radiographs, with or without supplementary photographs, do not provide enough information to reliably assess the underlying skeletal pattern in children 8 and 12 years old.

Assessment was less reliable at 8 than at 12 years of age. Prognathic patterns were not as readily identified as retrognathic patterns. Specialty training did not affect the correctness of these limited assessments.

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