The Significance Of Cephalometric Pattern Variations

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Roentgenographic cephalometry is rapidly assuming an indispensable role in the practice of orthodontics. Universal acceptance of this role will be enhanced when the cephalometric pattern of an individual patient can be stripped of superfluous implications and viewed in a significant and clinically practical manner. However, due to the biological nature of cephalometric measurements, hence their rule of variability, the significance of a cephalometric pattern is intimately related to a consideration of what is accepted as "normal variability".

The most reliable statistical expression of the normal range of variation is the Standard Deviation, (S.D.) which refers to the average deviation of individuals in a group from the mean of the group. Statistical computation indicates that the mean ±1 S.D. will include approximately 67% of the sample and the mean ±2 S.D. about 95%. For example, if the mean lower incisor-mandibular plane angle is 90 degrees and the S.D. is 5 degrees, angles of 85 degrees to 95 degrees will include 67% of the group, 80 degrees to 100 degrees will include 95% of the group, and 75 degrees to 105 degrees will include over 99% of the group.

Krogman and Sassouni[1] have stated in reference to cephalometric values, "The problem reduces itself, in actual practice, to the decision of when "normality" ceases and "abnormality" begins." They suggest, "It is probably a pretty good rule to accept ± 2 S.D. as fixing the bounds of normal — hence, acceptable variability. Beyond this, in the lowest and the highest of the total distribution, it is well to probe more deeply in the search of causation. And, for purposes of roentgenographic cephalometry, beyond ± 2 S.D. suggests that some sort of corrective treatment is indicated."

The various planes and their angular relationships, as used in a cephalometric analysis, are merely an expression quantitatively and qualitatively of the relationships of various parts of the human head. From the previous considerations it becomes apparent that the averages or means derived from these various measurements, for any specific analysis, should not be used as a norm or pattern into which we can expect to fit each individual encountered in the office.

Vorhies and Adams[2] recognized the need for an efficient method of graphically illustrating a static cephalometric analysis. Their cephalometric polygon utilizing Downs' analysis[3] permits the visual comparison of the cephalometric pattern of an individual patient with the values of Downs' sample of 20 patients varying in age from 12 to 17 years. Because of the "wiggle" nature of the polygon, however, equally drastic angular deviations may appear as unequal deviations from the mean and vice versa. One other question remains unresolved concerning the significance of this method of plotting a cephalometric pattern: Can the range of values, that determine the polygon's shape, of Downs' relatively small sample of individuals of varying ages be accepted

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as representing the normal range of variation for the patient under consideration.

The Department of Graduate Orthodontics, University of Nebraska, is now using a system of plotting cephalometric patterns that permits viewing variations in terms of Standard Deviations or "Z" scores. The values used in constructing the Z score charts are based primarily on data from Northwestern University.[4] These values have a higher degree of statistical significance than the values used in the Vorhies-Adams polygon because they are based on a larger sample of children in selected age ranges of 8 to 11 and also adults over 18 years of age, all possessing excellent occlusions.

The Z score chart is constructed by listing the mean values of various angles along a center vertical line. The mean values have been rounded off to the nearest integer. Whole number variations of a specific mean value up to ± 3 S.D. are then plotted horizontally. The scales used for horizontally plotting variations of individual mean values have been altered so that values representing ± 2 S.D. will fall on vertical lines equidistant from the line representing the mean values. The exact standard deviation for each measurement is listed at the right of the chart for reference. The skeletal and denture measurements are separated for convenience in plotting values. Space is provided on the chart for the patient's name, chronological age, and the skeletal age of the patient determined from a wrist x-ray.[5]

Generally, those values on the left of the mean indicate a Class II facial tendency and values on the right suggest a Class III tendency. However, this pattern does not apply to all of the measurements listed.

The chart illustrated in Figure 1 represents the variations in cephalometric measurements for a sample of children 8 to 11 years of age, all possessing excellent occlusions. Another chart is available which represents a sample of adults over 18 years of age, all possessing excellent occlusions.

The patient whose cephalometric pattern has been plotted in Figure 1 is a female, 11 years and 4 months of age. Her occlusion and facial profile correspond to the typical Class II, Division 1 pattern (Fig. 2). The variations of individual measurements from the mean values can be rapidly assessed in terms of standard deviations. For example, the SNa angle of 80 degrees for this patient corresponds closely to the mean value of 81 degrees while the SNb angle of 73 degrees deviates almost two S.D. from the mean value of 78 degrees. If another reference plane, Frankfort horizontal, is used to assess mandibular development by the angle FH-NP, the deviation from the mean value exceeds two S.D.

In the denture analysis, the angle of the upper left incisor to NS plane exceeds two S.D. from the mean placing it beyond the range of normal variability. The lower left incisor to GoGn angle falls between one and two S.D. within the range of normal variability.

The major advantage of the Z score chart over other methods of plotting a patient's cephalometric pattern is that it permits a rapid visual appraisal of the significance of variations in the individual measurements in terms of standard deviations. Because of the scale changes for different measurements, the range of normal variability is graphically apparent; thus, equally serious deviations of certain measurements from the mean will be viewed in their proper perspective as equally serious anomalies.

The Z score charts also suggest a more reliable degree of statistical significance than the Vorhies-Adams polygon because the values used in con-

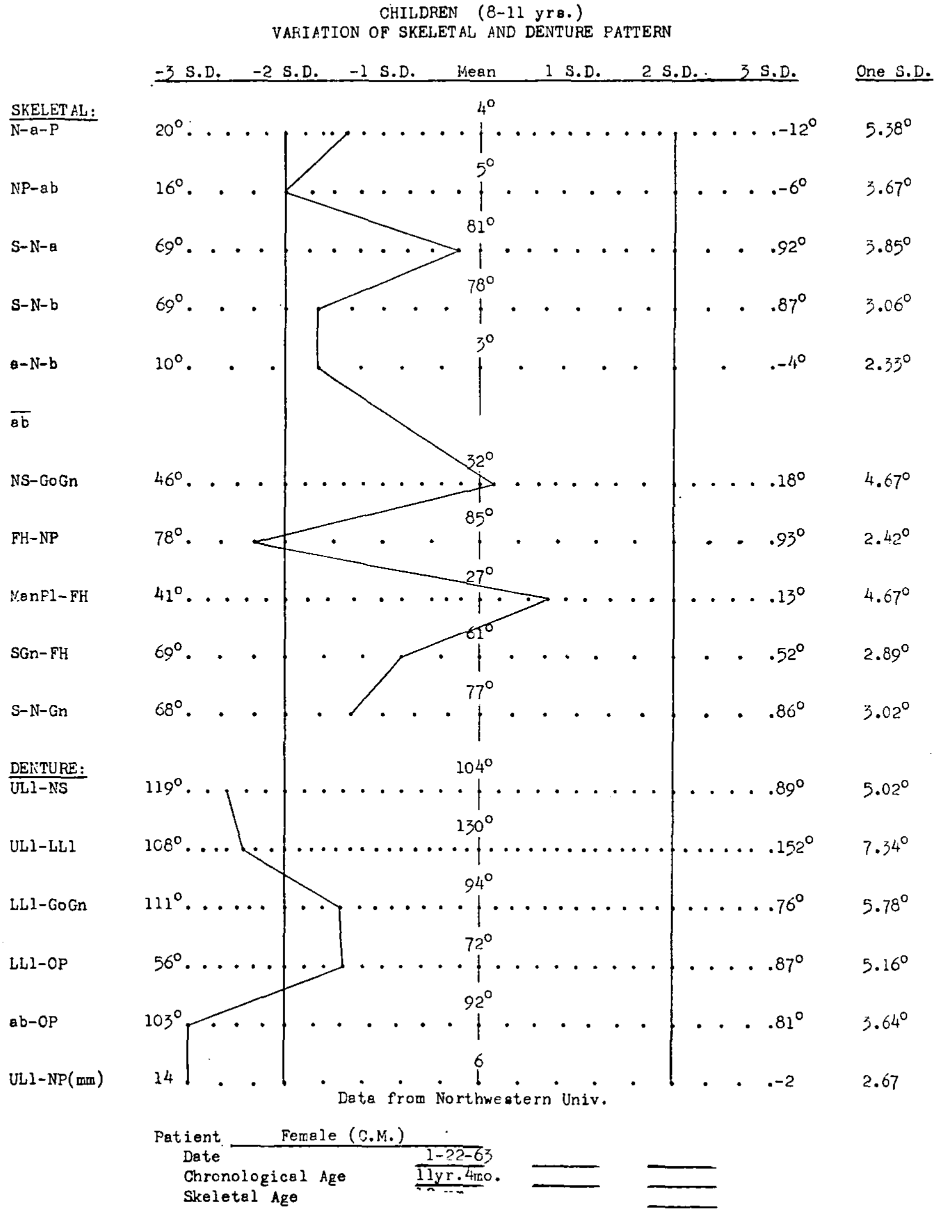

Figure 1 Graphic representation of the cephalometric measurements of a girl, age 11 years 4 months, presenting with a typical Class II skeletal and denture pattern. The deviations of various angles from the mean are viewed in terms of standard deviations.

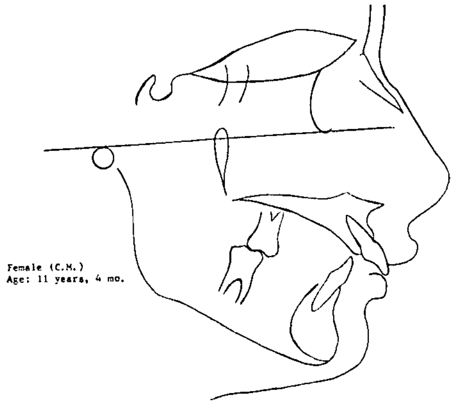

Fig. 2

struction of the charts are based on a larger sample of people in selected age ranges, all possessing excellent occlusions.

SUMMARY

A method of plotting the cephalometric pattern of an individual has been presented that permits visualizing deviations of cephalometric measurements in terms of Standard Deviations or Z scores. By changing the scale used in plotting various measurements, equally severe deviations from the mean values will appear as equally severe anomalies. By placing cephalometric variations in the perspective of normal variability, it is hoped that the cephalometric pattern of an individual patient will assume more reliable clinical significance in treatment planning.

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