Cephalometry needs innovation, not renovation

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We have long used lateral cephalometric films for quantification of skeletal changes or differences in the head and neck area; the technique allows reasonably rigid standardization in magnification and distortion of images. Because a cephalometric study looks for changes in size, shape, and orientation of the orofacial complex, multiple variables are routinely measured, using units of length, degree, and area. Measurements can be made to a fraction of a millimeter or degree, despite the fact that our clinical abilities do not reach such a level of precision.

Angles, i.e., ratios, may be the most common and oldest way of quantifying a shape, and they are still a popular tool. However, this method of expressing shape has several shortcomings. When studying shape, size variation may appear to be unwanted noise. From such a viewpoint, a clear distinction between size and shape can be considered the beginning of a morphometric study. Traditionally, size differences are expressed in terms of length or area, whereas shape differences are measured in angles. Although convenient, discrete number expressions of angles do not provide a global view of the shape change or the difference of the entire face. An increase in SNA of 3° does not inform us whether nasion moved backward, A-point moved forward, or sella moved downward. Therefore, we ought to measure many other angles around sella, nasion, and A-point to determine the nature of the change. However, it is difficult to determine what has happened in the face by looking at a series of angular measurements. Why? First, the numbers (angles) do not provide information about direction. Second, each number does not have a specific reference point or line that can be related to each of the other numbers. Most of all, this is not the way we perceive the changes in daily clinical life!

Abstract

Units of length, degree, and area are used when measuring cephalograms. In particular, the measurement of angles is a conventional method of quantifying shape. Because angles do not provide information about direction, there is no way to tell how and where one part of the facial structure has moved with respect to the rest. A new landmark data system using x- and y-coordinates is proposed, and some of its advantages over conventional methods are explained.

Key Words

Angle • Cephalometry • Coordinate data

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A number of ways of quantifying shape have been introduced, such as the Finite Element scaling method,[1] the Procrustes method,[2] the Euclidean Distance Matrix Analysis,[3] Bookstein's Edge-matching method,[4] and so on. Each method has its pros and cons. However, what happens in clinics every day is the superimposition of films or tracings, one on top of the other, to find differences or changes. The important point may be that changes or differences must be expressed in numbers with directions; then they can be analyzed statistically and viewed on a computer screen or paper. For that reason, landmark data in x-, y-, and z-coordinate forms are advantageous over any scalar form of measurement, such as length or angle because coordinate data are vectors. However, using vectors instead of scalars requires reference points to view the changes with respect to those points, and the reference points or line must reside in or on the anatomical structure. In fact, the vexing problem in cephalometry is not magnification or distortion of images; nor, arguably, is it that of presenting three-dimensional structures in two dimensions. The innate, fundamental problem is the difficulty of finding some homologous landmarks in the facial skeletons that are accurate, reproducible, and stable over periods of growth and treatments.

Generally, floating norms provide a clinical guideline for finding a harmonious facial shape, regardless of their size. However, even though each angular measurement falls within the first standard deviation range of the chart, an extreme combination of the measurements within the limits can produce noticeable disharmony. In fact, in the clinic, individual characteristics play a more important role than norm values. Not only ethnic, racial, and sexual differences, but also individual facial types become important in diagnosis and treatment planning. A new, practical method of dealing with cephalometric measurements must enable us to compare individual numbers to the norms, to measure size and shape separately, to provide visual comparisons in a global view, and to handle those numbers by routine statistical methods. Fixing abnormalities and aberrant functions are one goal to which we exert our effort, but creating a state of the art is equally important. Our cephalomertic technique could become more scientific through innovation than through renovation.

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References

1. Cangialosi TJ, Moss ML, McAlarney ME, Nirenblatt BD, Yuan M. An evaluation of growth changes and treatment effects in Class II, Division 1 malocclusion with conventional roentgenographic cephalomerty and finite element method analysis. Am J Orthod Dentofac Orthop 1994;105:153-60.
2. Goodall C. Procrustes methods in the statistical analysis of shape. J R Statist Soc B 1991;53:285-339.
3. Lele S. Some comments on coordinate-free and scale-invariant methods in morphometrics. Am J Phys Anthropol 1991;85: 407-17.
4. Bookstein FL. Size and shape spaces for landmark data in two dimensions. Stat Science 1986;1: 181-242.