Commentary: Variation of anatomical and centroid points in the human fetal skull

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Nanda[1] echoed the cry of the orthodontist using cephalometrics when he stated "There is no landmark in the human head that is truly stationary." At the same time anatomists agreed that prenatal facial growth was the fastest human growth of all. This combination rendered the task of finding a stable reference point in the fetal skull very bleak. For, starting from virtually a dot in space, the embryo and later fetus expands and develops into a recognizable human being, of which the face is but one structure. Further, since many bony structures have not yet formed, there is difficulty in identifying such anatomical points as are used by the orthodontist. In a scientific study, these difficulties can be met first by carefully standardizing the fetal head position for taking records, and second by defining points which can be located by other than anatomical means. One series of such points is mathematical, and includes centers of area derived from the radiographic skull projection. Dr. Trenouth has successfully accomplished both these approaches.

The concept of centroid analysis in cephalometrics has been with us for more than 30 years. But workers have been zealous to justify its existence in proving that centroid points are more stable than other points. In a sense, this has been unnecessary, for direct reference to the logic of Archimides,[2] or the mathematician Routh[3] had already established the stability of centroids in shapes. Studies on growth and variation have confirmed their logic, and this article offers further reassurance that centroids may be usefully applied even to the rapidly changing fetal skull.

In its early days, finding centroids in the skull outline was a tedious mechanical procedure. Today, with computer graphic facilities, it is simple, rapid and inexpensive. This means that the clinician can define one or more centroid based reference lines to which may be related any known clinical plane. For example, in the lateral headplate, if the centroids of the face, total skull and cranium are connected to form a straight line, the angle of the upper incisors to it will give a more reliable assessment of their degree of proclination or retroclination than if they are related to an anatomical plane, such as the sela-nasion or frankfort plane.

Someday, hopefully, the full potential of the centroid analysis already researched will be published more widely. Centroid points may be harnessed to create a cyclical curve (not unlike a sine wave) to generate a large family of planes, some of minimal variation to form reference systems and others highly variable to correlate with changes in head and facial form. One location on this curve defines the greater axis, and another the lesser axis of the shape, whether that be skull, cranium or face. The shape of the cyclical curve itself responds well to multivariate cluster analyses, with meaningful allocation of population head and face shapes. This cyclical wave is part of a three dimensional structure, and can be applied also to the frontal and vertex views for measuring symmetry and craniofacial form. In the future, clinicians should be able to turn to studies of this nature to refine and enchance diagnosis and treatment planning.

References

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