

FRANKFORT HORIZONTAL PLANE, FACIAL ANGLE AND FACIAL TYPE*

F. S. SEWARD, B.D.Sc., M.S. (Illinois)

There exists a very important difference between the Frankfort Horizontal and other cranial or cranio-facial planes which should be appreciated by all who use cephalometric analyses.

Whereas Dr. Downs in his analysis of cranio-facial form (1) related facial type (and the chin point) to the Frankfort Horizontal,

other workers (Steiner, 2; inter alia) relate facial type (and the chin point) to the sella-nasion plane. These latter workers preferred the sella-nasion plane to the Frankfort Horizontal for two reasons. First, they considered the sella-nasion (SN) plane more reliable, because they could locate both points determining this plane as anatomical entities in radiographs

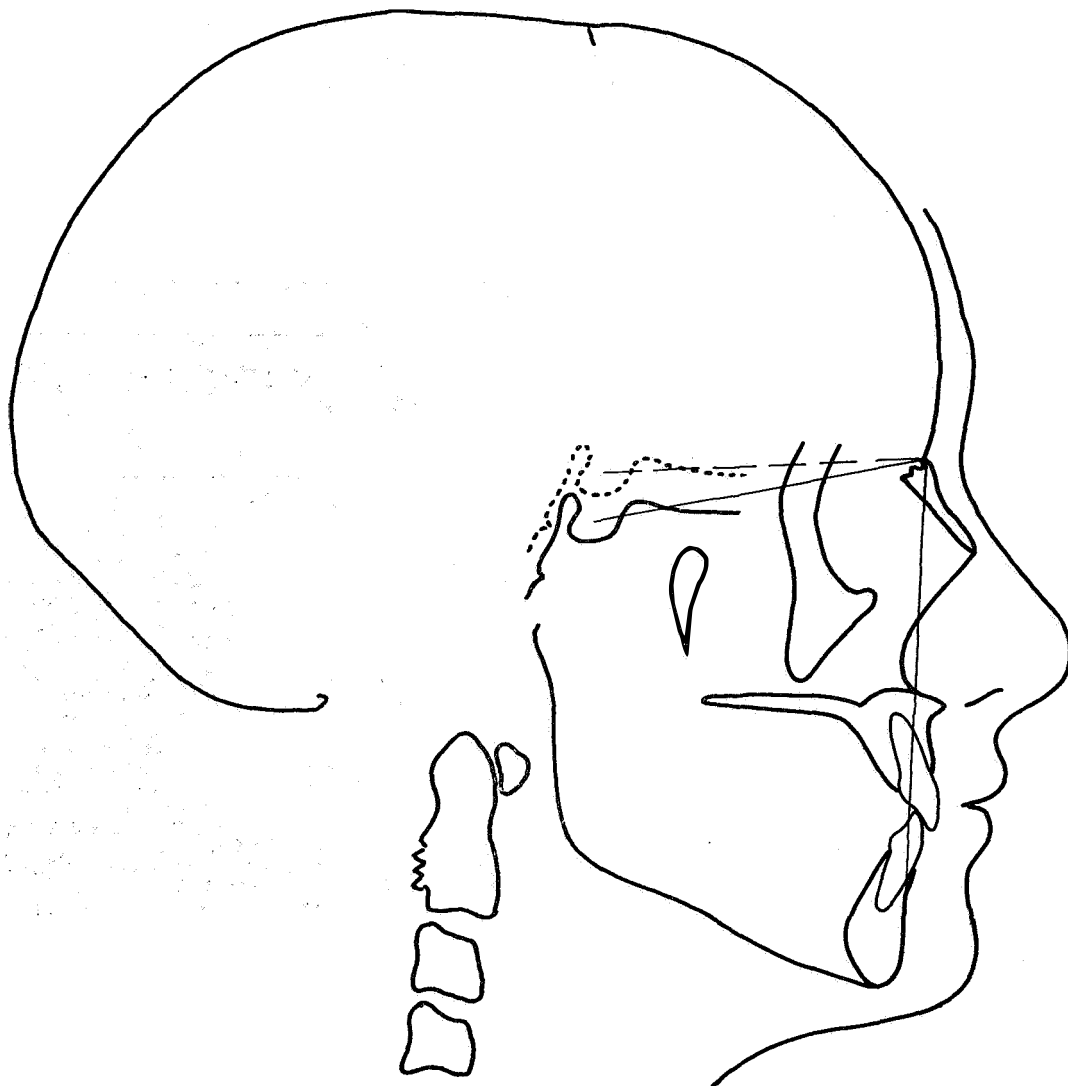


FIG. 1—Note that differences in the inclination of SN will alter the facial angle without changing the antero-posterior position of the chin.

*This work was supported by the National Health and Medical Research Council of Australia.

and were not dependent on the accuracy of the positioning of the ear rods. Secondly, in serial studies, they felt sure that SN had less "independent" movement; that it was a more stable plane than Frankfort Horizontal against which to relate changes.

These criticisms of the Frankfort Horizontal are not justified. On the contrary, for reasons which will be stated later, the Frankfort Horizontal is the better plane against which to relate facial type, and in serial studies it can be made equally as stable as any alternative cranial or cranio-facial plane.

To compare the relative variability cross-sectionally of these two planes, Downs (1) measured the angles between the facial plane (N-Po) and both the SN and the Frankfort Horizontal planes and found virtually the same range for both these angles. In other words, if the facial plane be considered the fixed arm common to both these angles, then the SN arm varies between individuals over an arc of 12½ degrees, due to different positions of S. Similarly, the Frankfort Horizontal arm varies in position over an arc of 13 degrees due to different positions of porion. If the errors in the positioning of the ear rods (from which the position of porion is determined) were commonly as large as the criticism of the Frankfort Horizontal indicates, then the porion end of this plane should be more variable than it is. Therefore, there is little to choose between the SN plane and the Frankfort Horizontal plane in respect of their variability cross-sectionally.

Downs used the Frankfort Horizontal because he wanted his numerical data to represent certain facial types, and to be able to use it to compare individuals. The use of the Frankfort Horizontal plane as a base line ensures that all persons with the same facial angle will have the same antero-posterior chin position. When SN is used as a base plane, individuals with the same facial angle will vary in antero-posterior chin position unless their SN planes are inclined at the same angle (Fig. 1). Any analysis for the comparison of individuals should incorporate a method of correction for variations in the inclination of the base plane in space. No such method is available for SN but such corrections can be made for the Frankfort Horizontal. Indeed, intelligent use of the plane demands that its inclination be checked, and corrected if not horizontal.

The inclination of the Frankfort Horizontal plane is determined from lateral posture photographs. Figure 2 shows the head of a girl, photographed while she was standing naturally and comfortably with her eyes looking straight ahead. It is a posture photograph. One notices her Frankfort Horizontal does not parallel the geographic horizontal plane. Consequently, before using Frankfort Horizontal plane in a cephalometric analysis of this girl, a correction must be made to superimpose the two planes.

One can measure, from both the photograph and from the radiograph, the angle the Frankfort plane makes with the plane joining the soft tissue profiles of the bridge of the nose and the chin. Also, one can measure on the photograph the angle this same soft tissue plane makes with the geographic horizontal plane (x^0). Then on the radiograph, a line is constructed at x^0 to the soft tissue plane bridge-of-nose-to-chin; this corrected Frankfort Horizontal will parallel the geographic horizontal.

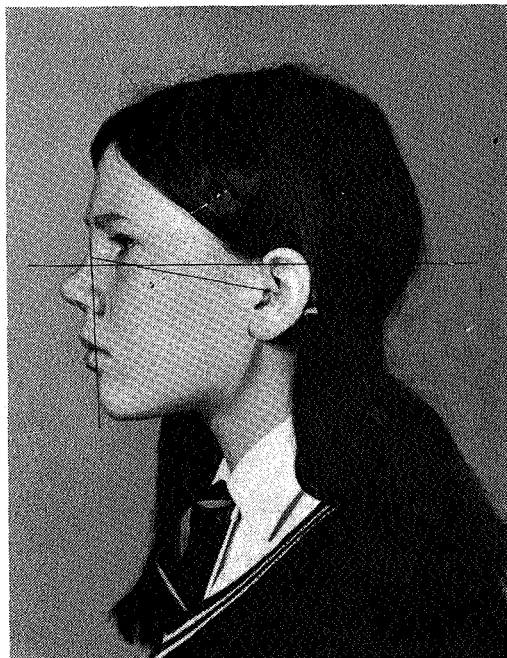


FIG. 2—Posture photograph illustrating Frankfort Horizontal, geographic horizontal and soft tissue facial planes. Note that when Frankfort Horizontal and geographic horizontal do not coincide, variations in facial angle result. The method of compensation for these variations is described in the text.

In the case illustrated (Fig. 2), it would be misleading to use an analysis based on an uncorrected Frankfort Horizontal to aid diagnosis and treatment, because an uncorrected Frankfort Horizontal would lead an orthodontist to

believe he was dealing with a child possessing a retruded mandible, and any treatment based on this assumption would be unsatisfactory. Fortunately, the use of posture photographs enables variations in the spatial position of Frankfort Horizontal to be detected and corrected. Similarly, spatial variations in N can be detected but there is no way of detecting variations in S. It is clear that the inclination of SN is dependent upon the positions in space of S and N and that, unless these are known, variations in the inclination of this plane cannot be corrected. Because the spatial variations of S cannot be detected, it would be unwise to assume they do not occur.

What then of the criticism that Frankfort Horizontal is not as stable serially as the SN plane and the conclusion that it is better to measure serial changes from SN? In part, this criticism of Frankfort Horizontal is justified. In a previous paper (3) the present author showed the serial unreliability of porion by comparing this point with basion and A-E*. Fortunately, this unreliability of porion can be overcome in several ways. The commonest is to measure the angular relationship of Frankfort Horizontal with the SN plane in the initial radiograph and then to construct Frankfort Horizontals on subsequent radiographs maintaining the same angular relationship. Thereby

*The tip of the arcuate eminence, an elevation of bone covering the superior semi-circular canal, and found on the anterior surface of the petrous part of the temporal bone.

Frankfort Horizontal is endowed with the stability of the SN plane. Indeed, using a similar technique, the Frankfort Horizontal can be endowed with the stability of any anthropometric plane.

Downs based his analysis on the Frankfort Horizontal because he wanted his numerical data to be similar or identical if derived from individuals of the same facial type. He realized Frankfort Horizontal was not always parallel to the geographic horizontal, but he could detect and correct this when it occurred (which one cannot do with SN). Furthermore, in serial studies, Frankfort Horizontal can be endowed with the stability of SN or any other anthropometric plane.

Frankfort Horizontal is the only anthropometric plane which can be made common for all people, and is therefore the best plane against which to assess facial type. It is the only plane which should be used to compare the facial type of one person with that of another.

REFERENCES:

1. DOWNS, W. B., Variations in facial relationships: their significance in treatment and prognosis, *Amer. J. Orthodont.*, 34: pp. 812-840: 1948.
2. STEINER, C. C., Cephalometrics for you and me, *Amer. J. Orthodont.*, 39: pp. 729-775: 1953.
3. SEWARD, F. S., Relative reliability of certain cranial landmarks used in cephalometric roentgenology, Thesis, University of Illinois, 1954.

16 Collins Street,
Melbourne,
Victoria,
Australia 3000.