

A geometric method for enlargement or reduction of head roentgenograms

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When head roentgenograms of the same patient were taken at three feet, four feet and five feet focal distances at different ages, the need arose for enlarging or reducing them to the same size. The photographic method introduces many distortions due to the shrinking and stretching of photographic paper under different conditions of humidity.

The following method eliminates all photographic processes and is accomplished on tracings drawn directly from the original head roentgenogram or a tracing therefrom.

PROOF OF METHOD.

Plate I; Fig. a, presents triangle T, with vertices (and angles) Bo, N, and Po. In Fig. b, the side Bo' N' is lengthened the desired amount of enlargement; the angles at Bo' and N' are exactly reproduced; the respective sides are extended until they intersect, which point of intersection is Po'; the angle at Po' is identical to the angle Po. (The sum of the angles of a triangle is 180°; since angles Bo' and N' were drawn equal to Bo and N respectively, Po' must equal Po.) Thus triangle T' is the same shape as triangle T but is larger, (see Fig. c), by the amount that the side Bo'N' was made longer than side BoN.

At the University of Minnesota head roentgenograms were taken of one skull, mounted in a constant relation to the

central ray of the tube, at focal distances of two, four, and six feet.

Plate II: Fig. a, presents a tracing of the roentgenogram of a skull taken at a four feet focal distance; the points Bo, Bolton point; S, center of sella turcica; N, nasion; and Po, pogonion were established. On another sheet of tracing paper Fig. b, Bo'N' is drawn the length of the Bolton plane as found on the head roentgenogram with a two feet focal distance; the angle at Bo' is drawn equal to that at Bo, and the angle at N' is equal to that at N; where the sides of these angles intersect determines the points Po' and S'. From Plate I, we know that in Plate II, Triangle T1' is the same shape but larger than T1; and similarly T2' is the same shape but larger than T2. Fig. c presents a tracing of the head roentgenogram taken at the two feet focal distance with the enlargement of Fig. b superposed along the Bolton plane, the points Bo', S', N' and Po' are seen to fall at their correct positions on the tracing.

Similarly, a tracing of the head roentgenograms at the four feet focal distance using the same points was reduced to the size of the head roentgenogram taken at the six feet distance and similarly the points were found to fall in the correct places, proving the method to be accurate.

METHOD:

Plate III: Fig. a presents a tracing of the head roentgenogram taken at the four feet focal distance locating the Bolton Plane and the points: Bo, Bolton point; P, porion; S, sella Turcica;

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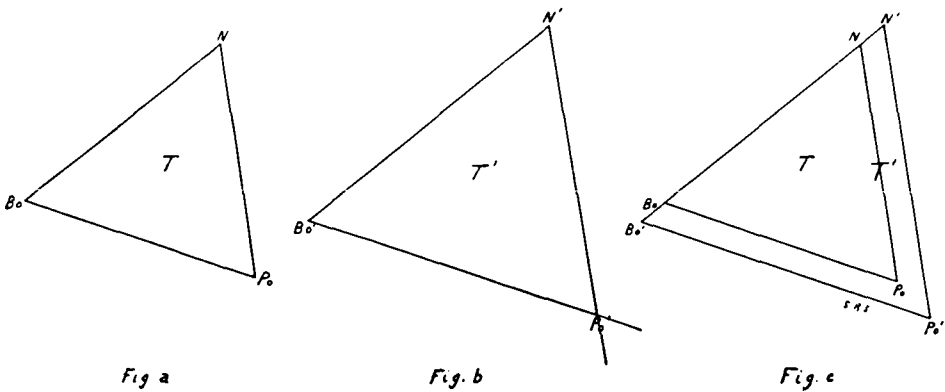


Plate I

N, nasion; O, orbit; F, posterior nasal spine; Sp, anterior nasal spine; A, subspinale; UI, upper central incisor incisal edge; UA, upper central incisor root apex; B supramentale; Po, pogonion. Fig. b: on another sheet of tracing paper; draw the Bolton plane $Bo'N'$ the length of that of the desired enlargement and superpose this sheet of tracing paper on Fig. a so that the Bolton planes overlap and N' coincides with N ; this leaves Bo' considerably beyond Bo . Draw construction lines (dotted) from NN' through and beyond each of the points shown in Fig. a. In Fig. c place this same sheet of tracing paper with Bolton plane $Bo'Nn'$ on Fig. a again so that the Bolton planes overlap, but

this time so that Bo' now coincides with Bo and N' necessarily will fall outside of N . Draw construction lines (dashed) from $BoBo'$ through and beyond each of the points designated in Fig. a. As shown in Fig. b, Plates I and II, concerning point Po' , where each pair of respective construction lines intersect determines the location of that point on the enlargement.

Plate IV: Fig. a shows the resultant drawing of the construction lines; and the Bolton plane $Bo'N'$ of Plate III, Fig. b and c. The intersections of each pair of construction lines locate on the enlargement each of the points shown in Plate III, Fig. a. Plate IV, Fig. b, employs the principle of concentric cir-

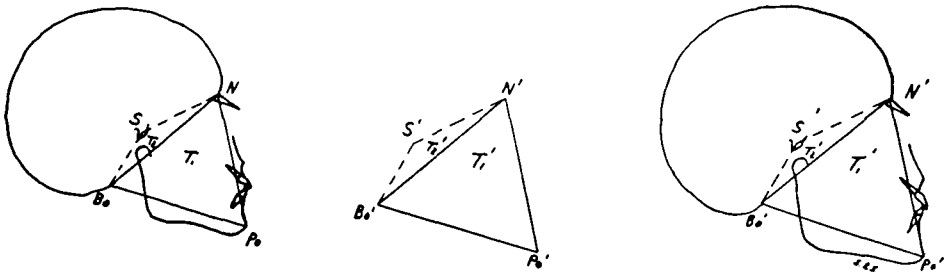


Fig. a

Fig. b

Fig. c

Plate II

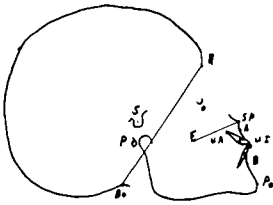


Fig. a

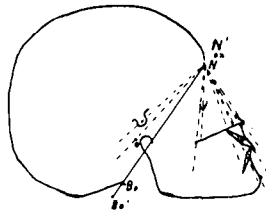


Fig. b

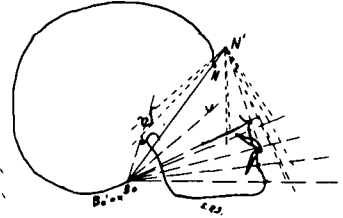


Fig. c

Plate III

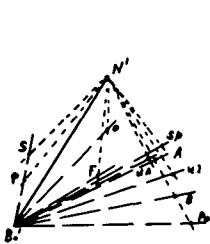


Fig. a

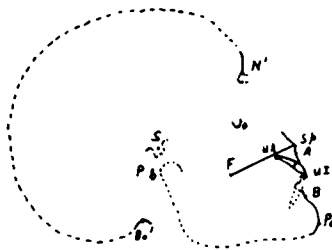


Fig. b



Fig. c

Plate IV

cles permitting the outline drawing of the enlargement in solid lines of those structures located by the points established. Had more points been established the entire dotted outline could have been drawn. Fig.c shows the original head roentgenogram taken at the four feet focal distance.

Usually there is no need for completing the outline of the head since points needed for determining an analysis can be individually located.

CONCLUSION.

This is an accurate method for enlarging or reducing any head roentgenogram.

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