The Angle Orthodontist

VOL. IX JANUARY, 1939 NO. 1

The Network Method of Orthodontic Diagnosis

DR. LUCIEN DECOSTER*

Brussels

THE broadening of the orthodontic diagnostic field to include the visceral skull or face, according to the new ideas of Van Loon, raised many problems. At present, after twenty years, there is not yet sufficient clearness about them. Dental occlusion, considered as the key to orthodontic diagnosis according to Edward Angle, appears as very simple in respect to the problems raised by the new ideas. Although in recent years some authors have raised many interesting questions about the development of dental occlusion, it remains the most accurately delimited part of the orthodontic diagnosis.

However, the addition of the new chapter brought us such a broadening of the scientific viewpoint that within the past twenty years a number of scientists have attempted to set the extended orthodontic diagnosis on a firm basis. At first researches were made in an attempt to discover the possible relationship between the dental arch and facial architecture, establish the level of orientation, and the anatomical points which might be suitable as real criterion points for reliable judgment. The planes of orientation were provided by anthropology and are of an incontestable scientific value.

But when an attempt was made to gauge the criterion character of the anatomical points of the bone, it was ascertained by statistical as well as by anatomical researches that none of these points afforded the necessary fixity. Particularly is this true during the period of growth and development. When many individuals are taken as a group, the rules of relationship are verified by the law of frequency. Taken separately, each normal individual does not absolutely confirm that relationship. It would be presumptuous to note as abnormal all the cases in which a given point does not fit in absolute accordance with the normal rule. In growing individuals, where there is a continuous change of relationship, the difference is so much the greater. A person, *grosso modo* considered as normal, does not need to possess all the normal relationships; first, because of the normal variation, and second, because the lack of one or another local relationship does not necessarily lessen our appreciation of beauty and normality.

The real point of normality does not rest in the existence of a normal conformity of all the points with a given law, but in the proportionality of the different parts one to another. The change of proportion is the real explana-

*Professor of Orthodontia, Belgian Institute of Stomatology.

tion for the changing aspect of the human features during growth. The lack of proportion denotes anomaly. That is the correlative normality. One part separately considered can be normal according to some law, and another part normal as well, but if there is not a normal proportion between the two parts, the two parts together will be abnormal.

Centuries ago, artists expressed and described the laws of facial proportion. Vitruvius, Michel-Angelo and others proposed rules of facial beauty. In certain paintings of Albert Dürer (1500) (Fig. 1), the original lines of proportion are still to be seen, and in others (Fig. 2) he demonstrated disharmony of the features and lack of proportion. On the other hand, the anthropologists

Fig. 1.—The face of a Madonna by Albert Durer (1471-1528). The lines of proportionality are clearly visible.

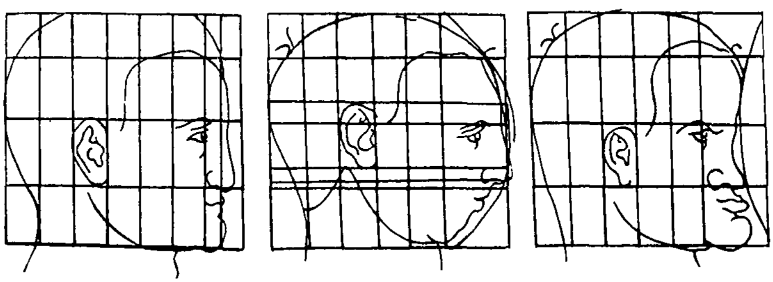

Fig. 2.—Drawing by Albert Durer. The painter endeavors to show the variation of the facial features in the three forms of faces.

and also the orthodontists devised lines of proportion (Frankfort plane, line of harmony, line of Dreyfus, Izard, etc.). We dare say that the notion of normality is a general sentiment of beauty based on the unconscious perception of the proportionate relationship of the different parts of the face. Correlative normality is based, on one hand, upon the correct position of each part of the facial architecture and, on the other hand, upon the relationship of each part to its neighbors and to the entire face. Of course, here also we shall meet with normal variation, but the multiplicity of the anatomical points taken together will be of great help in discerning where normal variation ends and abnormality begins. For we must bear in mind that a slight incongruency of one part may be compensated for in another by mere growth adaptation.

A method of analysis of this proportion demands the possibility of examination in the three planes of space. The day that brings us the possibility of exteriorization of the relative position of all the points simultaneously in three dimensions will bring us a definite and major step nearer orthodontic diagnosis. Up to now we must be content with planimetric projections of the proportions. If, on a composite scheme, produced by the study of several hundreds of normal cases (so that it may be considered as expressing the average of normal proprieties), we draw coordinate lines, parallel to the proportion lines of the artist, the anthropologist and the orthodontist, the connections of the lines with the principal points of the face may be considered as an exteriorization of the real proportionality of the normal face. If we take a

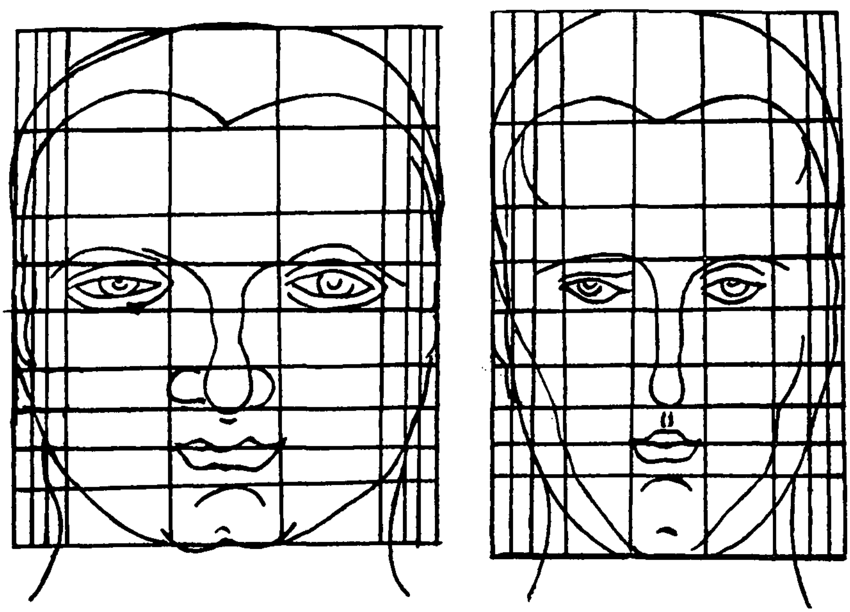

Fig. 3.—Drawing by Durer showing how the difference in type means only a difference of scale which the artist's network indicates clearly.

sagittal, frontal and horizontal projection of that face, it would be possible, with very little imagination, to develop a synthetic idea of the proportions of the face. The coordinate lines will not only bring out a certain relationship with the various anatomical mark points, but they will also describe on the schema of the face several areas, intimately related to the position of the anatomical landmarks. If one of these points is displaced and the next one remains in its normal place, we will have an exact idea of the points which became displaced and also of the deformation of the intersecting area. If the two points were displaced, their relationship with the other normal points will delimit their displacement and the movement of the whole region lying between these two points.

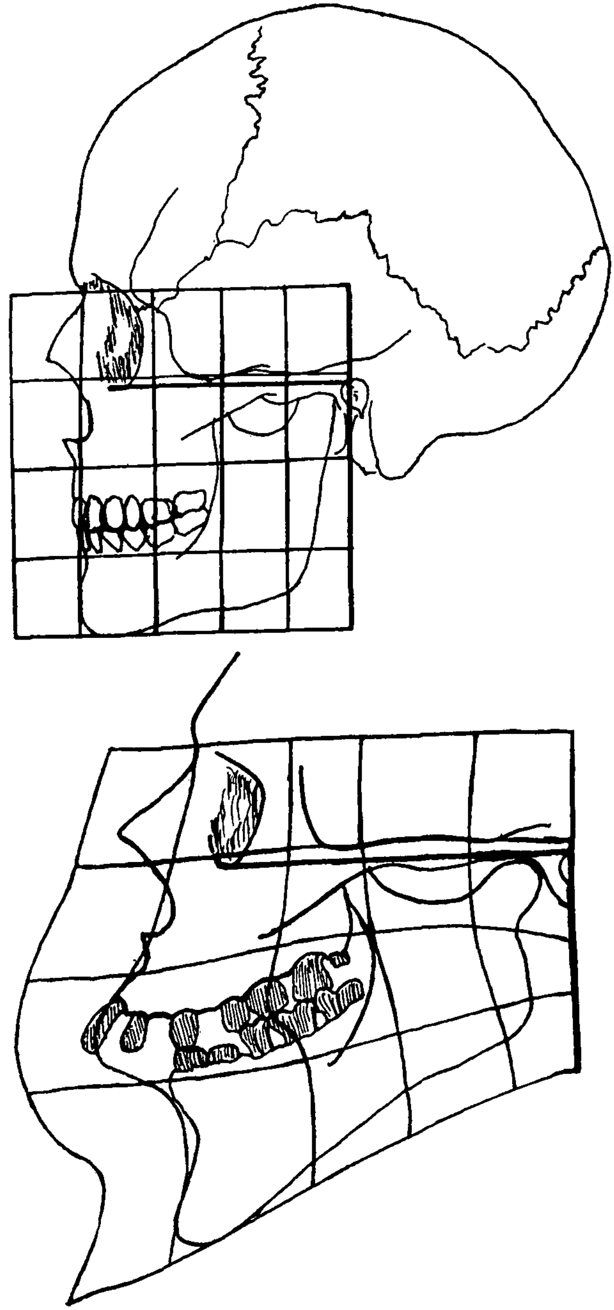

Fig. 4.—Rectangular network drawn on normal skull. Coordinate lines on second skull have the same relationship to the anatomical mark points of the skull. The deformation of the coordinate lines in the second skull give relief to the malformation of the skull. The proportionality of the different parts of the two skulls is rendered conspicuous. Very simple example of anamorphose.

Several difficulties of peculiar character are met with when attempts are made to put this method into practical use. In the first place the proportions of the face in childhood are not at all the same as in adult age. This is a fact of daily observation, confirmed by scientific study of changes in the child's face compared to that of the adult. When we apply the same network of coordinate lines to both the face of a child and that of an adult we can perceive it at a glance. Accordingly, it would appear necessary to have a schema of coordinate lines exactly convenient for the age of our subject. At this point, many difficulties are encountered. By what method can we express the real age of the subject? The birth age cannot be quoted as giving a precise idea of the developmental period of our patient. There is another method, previously used by Milo Hellman and based on the dental age. Instead of having

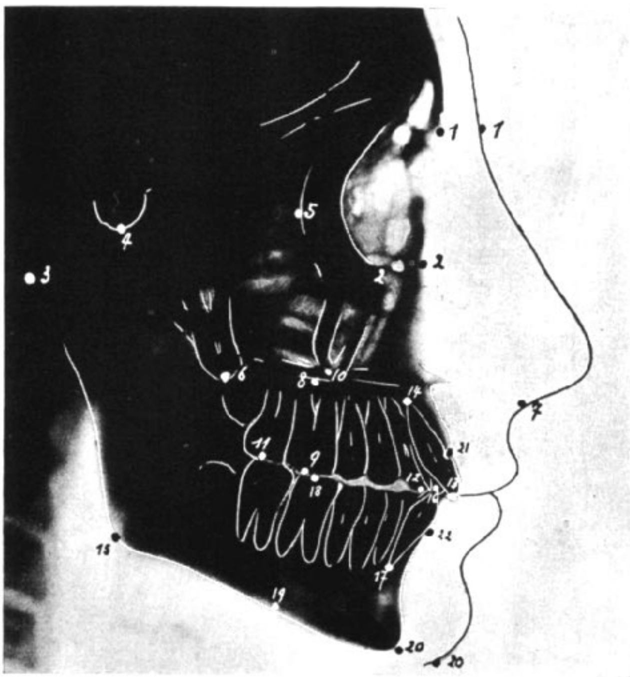

Fig. 5.—Normal teleradiograph of 18 years. The anatomical points are outlined and numbered. (See text.)

the age divided by years, he classifies it by developmental stages. There is certainly a great deal of exactness in the method of Milo Hellman.

Yet after the studies of Clinton Howard on the radiograph of the wrist and the conclusion that the developmental maturity of the osseous system is not always in perfect accord with the developmental stage of the dental system, it seems more convenient to take the age stage shown by this last method. It is the physiological stage of the osseous system or of the architectural features of the fact that we desire to record. This cannot be done better than by the physiological developmental stage of the skeleton. It would seem unnecessary to have coordinate schemas for each year of age, and it will probably

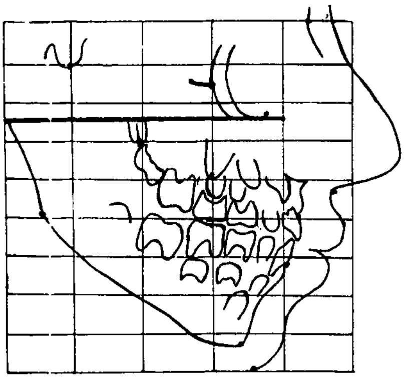

Fig. 6.—Typical schema from 4 to 6 years.

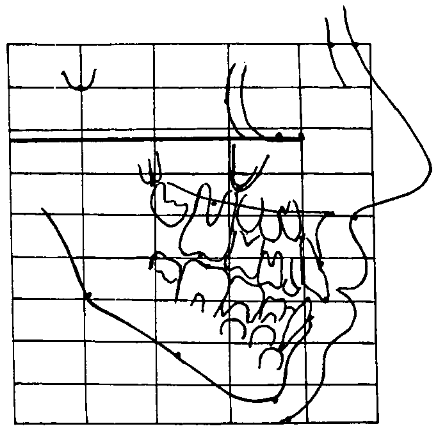

Fig. 7.—Schema from 6 to 8 years.

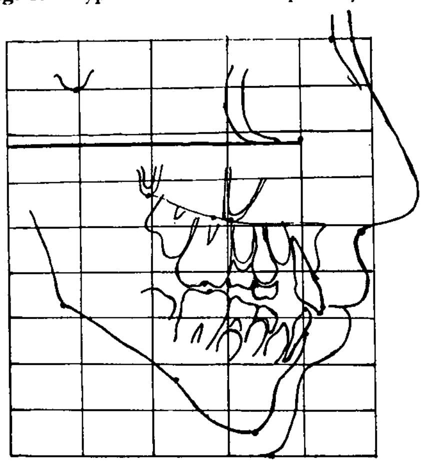

Fig. 8.—Schema from 8 to 12 years.

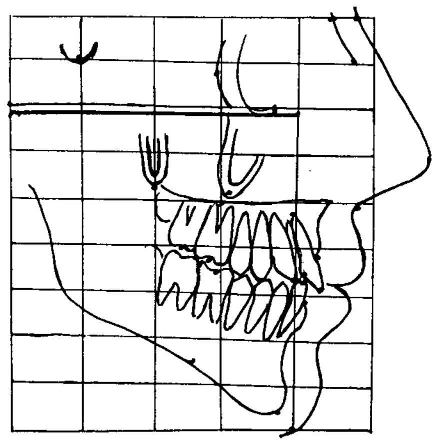

Fig. 9.—Schema from 12 to 15 years.

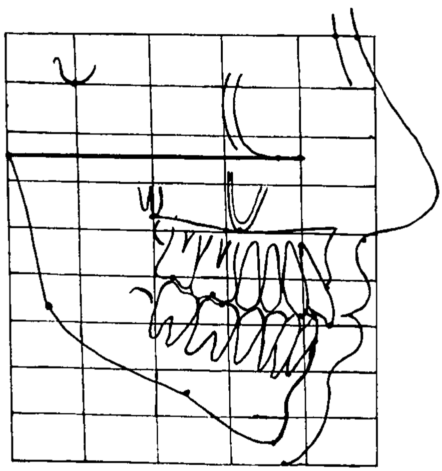

Fig. 10.—Schema from 15 to 20 years.

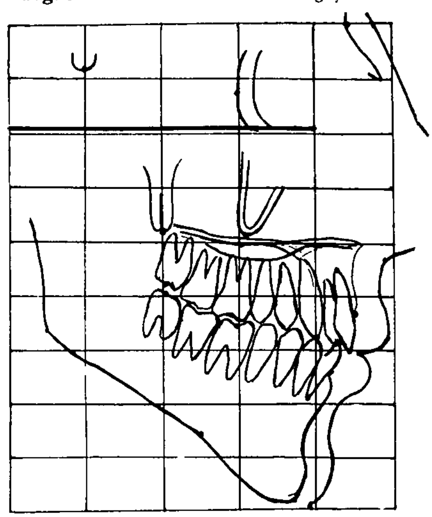

Fig. 11.—Schema of adult age.

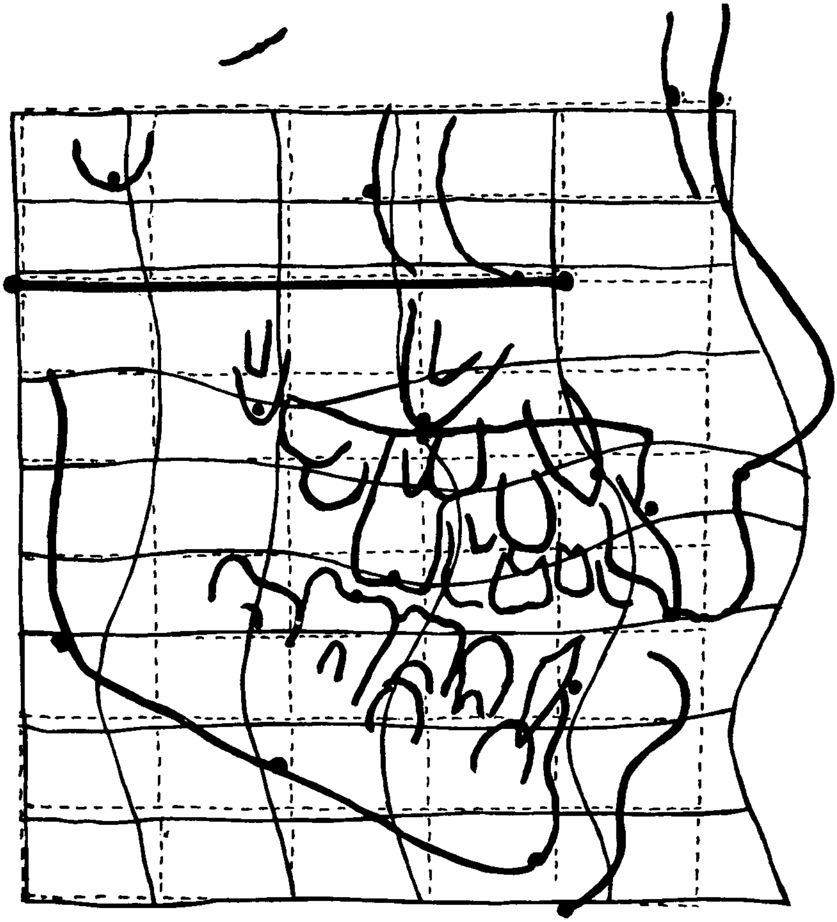

Fig. 12.—Sketch of a teleradiograph of 9-year-old boy. The radiograph of the wrist shows a physiological maturity of 7½ years. Consequently, we have to take the normal schema from 6 to 8 years. In order to show the succession of the different operations we have drawn on a transparent paper the normal schema reduced to a convenient scale (dotted lines). If we compare it with the normal relationship of Fig. 7 we can see some points that are coincident with the normal lines, while others are divergent. On a second transparent paper the solid black lines were deformed in such a way as to adjust the net to the anatomical points. We observe that the distal relationship of the lower molars is produced by the backward swinging of the lower jaw while the upper dentition seems to have progressed forward. The other peculiarities which are to be observed would require too long an explanation.

be sufficient to have them for the principal developmental stages. If we wish to have a more precise age record, as the developmental stage usually covers at least two or three years, it would be possible to draw the average, the highest and the lowest of the series for each age stage.

There is a second difficulty. Our usual typical schemas were obtained as a result of statistical work. They are only mathematical averages. It is evident that the morphology of our subjects can, of course, vary in a large way according to their own anthropological type. But the faces of dolicho- and eurydeveloping types, however their absolute measures may vary, nevertheless present the same proportionality. The only difference is a variation of scale. In order to avoid errors caused by a mere difference of scale, we will have to reduce our normal typical schema to the scale of our subject. (Fig. 3)

If, on a given face, we apply the typical network of the same developmental age, and if we also transform the scale of the net to a convenient one, we will observe that the anatomical and osseous landmarks of the face and the dental arches are not at all coincident with the normal network. It would be a very rare thing to find perfect agreement. Usually we will observe that some points coincide while others diverge to a greater or less degree. It would be possible to record for each of the points that diverge from the normal and from the other normal points. But this would really be a hopeless task and furnish but an analytical idea of the general situation and not a synthetical view of the condition.

There is another method of approaching these difficulties which offers us simultaneously an analytical and also a synthetic view of the morphological structures. D'Arcy Thompson and Heilman have used this method in their paleontological studies in order to show the process by which the early species of animals changed into contemporary forms. Cristallography uses a similar method. This is called the method of transformation of forms or geometric anamorphosis. It is based upon the idea that the malformation has been produced on a primitive normal pattern. Before that catastrophe a normal network would have revealed all the anatomical points in absolute accordance with the laws of normality. Subsequently, a deforming force threw the points away from their normal place as revealed by the meshes of the net. In other words, the method consists in the application of a normal network upon a deformed face and then in deforming the lines of the net in the same degree to coincide with the features of the face, thus deplacing the lines till they are in normal congruence with the chosen points. (Fig. 4)

When we deform the normal network by adapting it to the position of the anatomical points, the deformation of the meshes of the net will be the graphical expression of the divergence from the normal average. One comparative example may help to explain the matter. If I look at my face in a deforming mirror, I become aware and have a general impression of the deformation, but I am not able to analyze its exact extent. If I take on my face a rectangular network of coordinate lines and look at the mirror, the deformation of the lines will be of the same degree as the deformation of my features. If I study closely the deformation of the meshes it will be possible to have an exact idea of the deforming proprieties of the mirror and of the deformation of the reflection of my face, and I am allowed to say that the transformation of the network is an expression of the reflection of my face.

Practical Application

The first important need was the development of normal facial schemas. My first schemas were obtained from cephalometric measurements of more than 4,000 soldiers. Of this number 365 were considered as wholly normal with respect to facial and dental criteria. This data, worked out by statistics, permitted us to draw an adult typical normal schema. This was done ten years ago.

The number of children available for measurement for the growth ages was very low. I am perfectly aware that scientifically and statistically their number was too low. I measured but 400 children of the different ages. And, unfortunately, I was not able to materially increase that number. Notwithstanding, schemas were drawn in a like manner for children as for adults. The growth periods included:

a) from four to six years before the eruption of the six-year molars;
b) from six to eight years, after the eruption of the first molars,
c) from eight to twelve years (I believe that period too long and that it would be better to have an intermediate stage),
d) from twelve to fifteen years,
e) from fifteen to twenty years,
f) after twenty years.

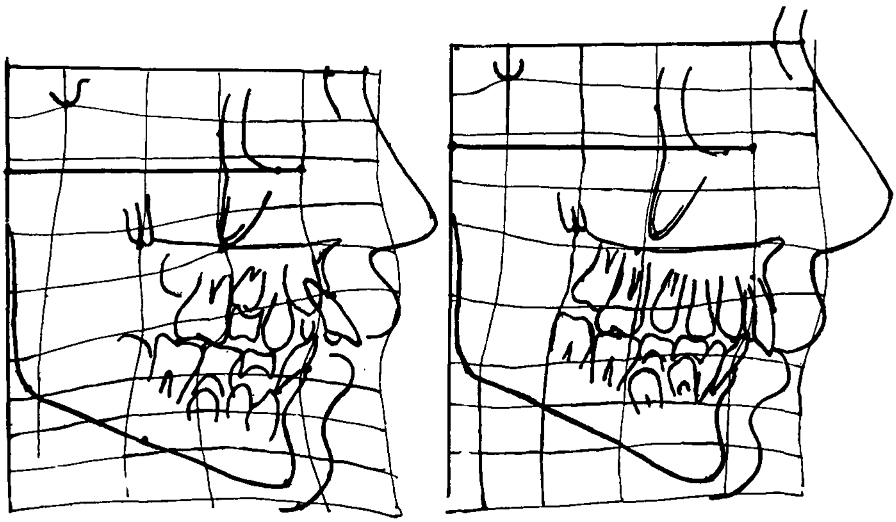

Fig. 13.—A, before, and B, after treatment. Two successive teleradiographs before and after treatment of a Class II case (Angle). The first one (A) was taken at ten years, the second (B) two years after. It is very interesting to observe the modifications brought about by the treatment. The first mesh is built upon the normal type of 8-12 years, the second one on the type 12-15 years. By so doing the modifications brought about by mere growth are discarded and the only differences remaining are those produced by the treatment. As can be seen, the coordinate lines are nearly straightened, at least for the upper jaw. The lower jaw remained behind and the gonion did not come forward. In the upper jaw the most striking fact is the vertical development of the maxillary sinus.

These schemas obtained by cephalometric measurements afford a very low number of available anatomical landmarks. The fixity of each one of these points can be discussed, but the results of the mesh analyses were, nevertheless, more satisfactory than the results of most of the other methods.

Another objection to the method included the difficulty of the measurement and of projecting the obtained data on paper. When the teleradiographic method came into general use for diagnostic purposes, all the difficulties of taking measurements and projections were overcome. Above all the number of available anatomical landmarks was so greatly increased that it became an easy and gratifying matter.

But another difficulty arose. Our typical networks were not fitted for teleradiographs, and the production of a sufficient number of normal teleradiographs as a scientific background for statistical application is not a small task. Previously I did not have a sufficient number of normal teleradiographs, so we were obliged to try and overcome the difficulty by drawing composite schemas with the addition of the particular teleradiographic landmarks on the cephalometric schemas. I hope that in the near future I will be able to obtain a sufficient number of normal teleradiographic pictures for the establishment of accurately recorded radiographic schemas.

Let us now have a review of the interesting anatomical points revealed by the radiograph: (Fig. 5)

1) Nasion point, the osseous point and the skin point.
2) Inferior orbital point, osseous point and skin point.
   The skin points are necessary for the orientation of the head during the taking of the pictures. The osseous points will prevent errors of position of the skin points.
3) Tragion.
4) The sella turcica. We will record the middle point of the inferior border.
5) The posterior border of the processus orbitalis externa.
6) The lowest point of the processus pterygoideus. That point may be considered as the posterior limit of the maxillary sinuses, and also as the posterior limit of the palatine basal plate.
7) The external naso-spinal point. (The vertical line of the 7 is crossed in the illustration F, as is customary in German writing—Ed.)
8) On the palatine plate a point is taken just above and between the roots of the first molar.
9) Another point lies in the middle of the occlusal plane of the molar.
10) The key ridge point, or the lowest point of the processus maxillo-zygomaticus.
11) The middle of the occlusal plane of the most posterior, yet fully erupted molar.
12) The cusp of the fully erupted canine.
13) The middle point of the incisal border of the central incisor.
14) The apex of the central incisor.
15) The osseous gonion.
16) The incisal border of the lower central incisor.
17) The apex of the lower central incisor.
18) The middle point of the occlusal plane of the first lower molar.
19) On the lower border of the horizontal branch of the mandible a point lying in the central long axis of the lower first molar.
20) Gnathion, osseous and skin point.
21) Prosthion.
22) Infradentale.

These different points, through their own position and through their relationship each with the other, allow us a complete insight into the structural peculiarities of the face. The development of the different parts of the face, the mutual relationship of the face to the cerebral skull, the inclination of the dental axes and of the various structural planes, such as the palatine plane, the occlusal plane, the mandibular plane, as well as the different angles, are, at least for the sagittal projection, entirely revealed by these points.

In the beginning I also drew frontal and horizontal projections, but it was quickly shown that the sagittal projection can give us almost all the structural elements of the face. The frontal projection is a difficult one by radiograph, owing to superpositions perspective; while a simple occlusal film of the dental arches gives us a most interesting idea of the horizontal relationships of the erupted teeth with those not yet erupted.

Usual Technic

On a good teleradiograph all the useful points can be easily observed. We can draw our network directly on the film itself, or draw on the negatoscope a simple sketch of all the anatomical points in order to use it for the network. I think the second manner is the best, for it does not spoil the radiograph.

As the first step we have to orientate our radiograph according to the Frankfort horizontal plane. (Figs. 6-11). From the tragion point a straight line is drawn to the inferior orbital skin point. (3-2, Fig. 5.) We then draw a line through the tragion point perpendicularly to the horizontal plane. At right angles to this last line and parallel to the horizontal line another is drawn through the nasion point. (7, Fig. 5.) The latter will represent the Krogman plane. The vertical tragion line and the Krogman line remain undeformed. They form the superior and posterior limit of the deformable area of the face. This larger quadrangular area will be divided by the coordinate lines in vertical and horizontal direction into a certain number of smaller quadrangular spaces which may be considered as the meshes of a network. There are six lines in vertical and ten lines in horizontal directions. Anteroposteriorly the face is divided into five parts, while in the vertical direction there are nine parts.

Our first task will be to get the lines on our sketch in the true scale. The Krogman line is drawn and now we draw the inferior line of the schema passing through gnathion. (20, Fig. 5.) This line must be parallel to the Krogman line. It will be easy to divide the distance between the Krogman line and the gnathion line into nine equal parts.

In the sagittal direction we are obliged to draw first the vertical line passing through the inferior orbital point, perpendicular to the Frankfort horizontal line, because in the front part the nasion point does not fall upon a line. The distance between the orbital line and the vertical tragion line is divided into four equal parts. The sixth vertical line, the anterior, is drawn at the same distance from the fifth.

Now we take the typical schema of the developmental age of the patient (age stage according to the physiological stages obtained by the radiograph of the wrist). (Fig. 6-11.) It will be seen that while a certain number of points coincide with the typical schema, some of them are divergent. We will now have to deform the lines in the neighborhood of our divergent points in such a manner that they recover their normal relationships with the lines of the standard chosen. (Fig. 12.) If the point in question should be crossed by a line it is easy to deform that line to make it cross the point. But if a point belongs in the middle of the mesh we will have to deform the neighboring lines in such a way as to make the point assume its place in the middle of the new mesh. There is practically no difficulty about it. One after the other all the divergent lines are transformed. The lines whose position is not determined by any point will follow the general movement of the neighbors. Perhaps it would be preferable to begin with cases showing very little deformation in order to arrive at a good understanding of the technic. After sufficient practice one will be able to place and deform the network without the first step.

What about the place of the mesh method in general orthodontic diagnosis? The mesh method is able to give us a good idea about the development and deformations of the various parts of the face. With respect to the cerebral skull, it will also determine the relative position of the dental system within the architecture of the face. It was not intended to serve as substitute for the usual diagnostic methods of the dental arches, but only to overcome one of the shortcomings of those methods. In the cases in which the usual dental methods fail to give sufficient information, the mesh method may throw some light upon the relationship of the facial features. In some cases the mesh method will supply us with useful information about the effects of our therapeutic efforts on the facial structure. (Fig. 13a and b.) When our mechanical means have succeeded in producing a convenient occlusal situation, the mesh analysis will reveal the real architectural changes brought about by our treatment.

Comment

In the study of malocclusion this method will be interesting in showing the interrelation of certain special forms of malocclusion with a particular osseous feature. It is not at all a micrometric method; biology hates mathematics. It permits a more comprehensive view of the intimate growth mechanism than mere inspection. It accounts for the normal variations and affords to clinical experience its normal place. As the deformation of the net gives an idea of the absolute deviation from the normal type, it is possible, by a simple mental process, to straighten the deformed lines and compute the required changes to make it normal. It is also possible to record it by a simple graphical method called interpolation. Therefore, we have only to straighten the deformed lines to their normal configuration.

The results of our treatment will perhaps remain largely behind the required ideal transformation because there is only an indirect relationship between our mechanical treatment and the very intricate and complex osseous situations of the deformed cases. But, fortunately, Nature afterward will give us generous help as a reward for our good will.

1 A Rue Archimedes.