

General considerations of the diagnostic problem*

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It is axiomatic that an understanding of the abnormal phases of any living thing must be based on a sound knowledge of the normal phases of the same thing. Diagnosis is, in every case, an attempt to answer the question, in what way does this depart from what it should be? The joker lies in knowing what it should be because of the implication that there is a standard against which the particular characteristic or factor may be laid, a gauge or measure of what is acceptable. A brief review of orthodontic history reveals that standards have been of different types and that these have changed with time. Indeed, different men have held different views as to the standard during the same period of time.

The first standard that was ever employed was undoubtedly that of esthetics because as early as the Romans it was pointed out that there were such things as irregular teeth and the advice was given by Celsus that if a tooth were to erupt out of place it could gradually be pushed into its correct position by pressure of the finger. This implied a standard of correct position. In the early days of the health professions the matter of irregular teeth received some consideration but a scrutiny of the writings of those days reveals that most of this attention was directed toward irregular teeth of the maxilla. Thus, the standard was an

even and attractive row of upper teeth. As time went on the lower arch began to receive attention and since the anterior portion of the mouth is the one that is exposed to the view there eventually developed an interest in the relationships between the teeth of the upper arch and the lower arch, but only in the incisal region. As early as 1803 Fox published a description of the varieties of irregularities of the teeth. In 1819 Delabarre introduced a classification and in 1836 Blandin listed four different classes based on variations that might be found in individuals. He stated that there were varieties in number, varieties in form, varieties in direction and varieties in position. In that same year Kneisel advanced another four-fold classification. Practically all of the emphasis in these early classifications was placed on the position of the upper and lower incisors relative to each other. In 1842 Carabelli advanced a six-fold classification which indicated an interest in total arch relationships. He listed the normal bite, the edge-to-edge bite, the open bite, the protruding bite, the retarding bite, and the cross bite. But as late as 1904 Iszlai had returned to a classification based on the relationship of the maxillary to the mandibular incisors. This was the last that was to appear after Angle had introduced his classification.

The Angle classification of 1899 was monumental in its simplicity. It pointed out the obvious fact that the mandible could assume only three possible relations with the maxilla, namely, normal,

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forward or backward. All other considerations, such as the malposition or even anomalous forms of individual teeth, were brushed aside and no attention was paid to medio-lateral relations, that is, cross bites.

As we all know, the range of variation that differentiates the Class II from the Class III molar relation is relatively small, not much if any, greater than the mesiodistal diameter of that tooth. It was therefore necessary for Angle to state very precisely just what the normal molar relationship was. You will remember that he said that the mesiobuccal cusp of the upper first permanent molar must be received in the buccal groove of the lower and that the mesiolingual cusp must rest in the central fossa of the same tooth. But this was just the beginning.

The study of selected, well-proportioned dentures in skull material quickly revealed to Angle that when this precise molar relation existed all other teeth in the arches seemed to have similar precise relations both within the same arch and between the two arches. There resulted the most complete analysis of normal interdental relations that had thus far been advanced. It took into account the relationship of the incisors, the canines and premolars, and described all of the minute details such as contact points, inclined planes, and cusp and fossa relations that went to make up what he called normal occlusion. Angle pointed out that there was a two to one ratio between all teeth, that each tooth rested upon and received mutual support from its neighbors, that there was an interdependence between the teeth of the maxilla and the mandible, and that there were certain teeth which seemed to be more important than others in the determination of the normal denture.

This classification was so clean cut and was so susceptible to interpretation

and understanding on purely morphological and mechanical grounds that it received almost immediate and universal acceptance. But it should be emphasized that the classification was based strictly on a norm of tooth relationships and diagnosis was a matter of describing deviations from this norm. Had Angle not insisted on the importance of the maxillary six year molar as a point of reference for classifying jaw relationships probably no controversy would have arisen. But this one point offered the excuse for an attack on the entire concept.

It was a matter of common experience with dentists that teeth, including the first permanent molar, could move out of normal position by drifting, if one of the adjacent teeth were lost. Hence the cry was raised that it was absolutely incorrect to base a diagnosis on anything as subject to change as the position of the maxillary first permanent molar. In short, the classification was accepted so long as it was restricted to the teeth alone. Controversy arose as soon as the attempt was made to discover relations of the teeth to structures outside of the denture. Angle worked for the next six years to produce evidence to support his contention that the maxillary six year molar was a reliable landmark. His conclusions were stated in his paper, "On the upper six year molar as a basis for diagnosis in orthodontia". And it is of great interest to note that he spent no time in defending his ideas on purely dental relationships. He left the concept of teeth as independent entities and stressed the relationship of one particular tooth, the maxillary first permanent molar, to the face in which it was housed. The trend of his thinking was revealed by such passages as, "Nature uses the greatest care in the placement of these teeth." He referred to them as guides to the correct placement of all of the other

teeth. Diagnosis now began to expand beyond the teeth and to include the bones which held them. During the five or six years he was preparing to answer his critics, orthodontic diagnosis continued to be based strictly on the occlusion of the teeth without reference to the bones that held them. As soon, however, as he started to relate this tooth to the bony scaffolding of the face he was entering upon a different type of diagnosis.

It should not be inferred that Angle was the only person who was thinking in these terms. A number of years before, Van Loon had advanced a method of relating dental casts to masks of the face. He felt that it was necessary to show the relationship between these two different parts. Here in the United States, Case was doing something that was almost identical, placing or inserting plaster casts within facial masks in order to indicate the relative position of the dental arches to the lips, cheeks, and face, which they supported. Thus, it might be said that the general trend of orthodontic thinking of the times revolved around a concept of morphology, a concept that dealt in terms of the relationship of one part to another. However, Angle's insistence on the perfection of interdental relations that should prevail as a result of orthodontic treatment was to determine the direction that orthodontia was destined to follow for the next twenty years. He advocated treatment that would result in such perfection.

Angle's results were criticized by many as being too toothy, after he had completed his regulating. This does not necessarily mean that all of his cases were toothy but rather that there were a sufficient number of them to make them noticeable. Then came his observation on the famous Hunning case. You will remember this was a case that he treated without extracting any teeth,

only to have it result in an unpleasing prominence of the dental arches. Viewing the same case several years later, he noted that now the dental arches bore very harmonious relations with the rest of the face. He reasoned that this change, this improvement, had been brought about by function. This one experience and probably others of a similar nature, led him into a completely new concept, which I have called the 'functional concept of development.'

Briefly, Angle held that if the teeth were placed in their normal positions in relation not only to the teeth of the same arch, but with those of the opposing arch, and if vigorous, normal function were established, the stimulation thus imparted to the bone around the teeth would develop a normal face for that individual. He summarized these findings in his paper of 1911 called "Bone Growing," and in that paper he said that his own observations had been recently strengthened by those of Oppenheim who had just published his classical work on the response of tissues to tooth movement. Oppenheim had quoted Wolff's law and had said that the changes in the tissues surrounding the teeth as a result of orthodontic tooth movement were a perfect representation of the working of that law. I have spoken to you about these matters on a number of occasions in the past and I shall not dwell upon them any further except to point out that whereas the classifications that had preceded this concept were based on static morphology, the introduction of the functional concept brought function into the picture and diagnosis thereupon began again to change.

By the time the 1911 paper had been written Angle had already perfected and discarded the "E" arch appliance and it was in 1911, as a result of his change in concept, that he introduced

the pin and tube appliance. This mechanism proving too difficult for the average practitioner to handle, he introduced the ribbon arch in 1917. Each of these mechanisms was a little more exact, each was a little easier to handle than the previous one, each gave more precise control over tooth movement. In short, it was becoming a little easier to obtain those movements that the orthodontist desired. Experiencing less difficulty in the movement of teeth, orthodontists began to seek etiologic factors that would explain the malocclusions that they encountered and it is not surprising that they should seek these in environmental factors. A great wave swept the profession characterized by adherence to the idea that in practically every case of malocclusion some habit was the basic cause. There were those who held to thumb sucking and finger sucking; Dewey even advanced the idea that the constricted arch of the mouth breather was due to the lack of positive air pressure in the nasal cavity. Others sought leaning and sleeping habits and all manner of devices were employed to break these habits and thus eliminate the causes of the malocclusion. In short, diagnosis came to be, instead of a study of morphological relationships, a search for environmental and mechanical factors that would explain the dental relations found in any case.

It was in this atmosphere with its reliance on the concept of functional development that Angle introduced his last appliance, the edgewise arch. Actually he trained very few men in its use and yet the mechanism quickly gained wide popularity. One of the greatest advantages possessed by the appliance, or so Angle thought, was the possibility it accorded for the return to the preformed arch, or as he now called it, the ideal arch. The mechanics underlying its use were so clear cut and positive that this and this alone would have as-

ured its acceptance. Actually, the ideal arch did more to retard biological, orthodontic thinking than any other single thing. It was seized upon as an easy way of predetermining the positions that the teeth should occupy and it was thought that all that was necessary was to obtain bracket control on an ideal arch and the case was as good as finished. You all know the results by now. The incisors were almost invariably carried into marked labial inclination, the mouth was given an unpleasantly prominent appearance and we were faced with the same conditions for which Angle had been criticized in his treatment with the "E" arch.

In retrospect it seems strange that with all of the attention devoted to morphology, to function, and to the varying results of treatment, that little or no attention was paid to the matter of growth, that is, to changes that might occur with age. It seems doubly strange that those professions which deal with the human organism during its period of greatest growth have until recent years contributed so little to our knowledge of the phenomena associated with that process. Pediatric literature is almost barren of research on growth and it has been only during the last few years that the orthodontist has begun to contribute to this field. Methods of research used before the period of which we are speaking had made no attempt to employ a longitudinal approach, that is, an approach that embraced a significant span of time and were thus susceptible to indicating changes that might occur in the organism. This was due principally, of course, to lack of a method for such study. Roentgenographic cephalometry offered the method that led to the fundamental researches that have been conducted since 1930 and these researches were destined to reveal quite quickly that many of the tenets underlying the functional con-

cept of development could not be sustained. It was in 1936 that the staff of this department showed by these means that the orthodontist was not affecting the changes that he had previously claimed and that in those cases where significant changes accompanied treatment they were largely the result of the natural processes of growth and growth alone. Curiously enough, however, the findings on growth in that work were destined to be more or less completely ignored while emphasis was placed on the negative findings, that is, to those findings that pointed to the limitation of orthodontic treatment.

Great attention was paid to the finding that teeth, carried into unnatural inclinations were not straightened up by function and when it was shown at the same time that the orthodontist was not capable of doing some of the things he had claimed through functional development there developed an attitude of despair. Now environmental factors were completely discarded; one heard nothing of habits, of musculature, of lips, of tongue; one heard only of heredity and the fact that the orthodontist could not do what he had previously claimed to do. It was in this kind of an atmosphere that the pattern concept was introduced in 1940. This piece of work tended to show that the individual pattern was a very stable thing and although it grew, it maintained its proportionality and its form with remarkable tenacity. This furnished further excuse for failure but now the excuse was offered on the grounds of scientific findings. If the pattern could not be changed and if orthodontists were not capable of growing bone or developing the face, there was only one way out and that was the extraction of enough dental units to make it possible to bring the denture into an acceptable relationship with the rest of the face. This then was a right-about-face, a rapid return

to the original concept of esthetics.

Esthetic standards are purely subjective measures, a point that seems to have been missed and one that has clouded our thinking now for almost twenty years. Even the ancient artists sought in vain to find canons or gauges, standards by which they could express esthetic values in objective terms. The various planes, angles, proportions and dimensions that underlay the art of ancient Greece had been added to through the Middle Ages and had come down to the present day. Something of a similar sort was now attempted in orthodontia. We began to hear of incisors that stood at a 90 degree relation to the lower border of the mandible; of incisors that stood directly over so called basal bone. The reasoning behind this tenet was that teeth standing in such a position were held to have greater mechanical advantage in mastication because in this position functional force was transmitted directly down the axis without lateral stress. All this was, of course, in the face of the evidence of comparative anatomy that such a right angle relationship was not at all necessary for completely satisfactory function. For a while, however, the major tenet of diagnosis was the relationship of the lower incisors, first to the lower border of the mandible and then to the occlusal plane. And if a right angle or nearly a right angle relationship could be obtained this was considered all that was necessary to insure permanency of result and pleasing physiognomy. Again it was roentgenographic cephalometry that pricked this balloon because it showed very quickly that completely normal dentures might have the right angle relationship of incisor to either occlusal plane or lower border and still be in markedly procumbent positions as judged by the rest of the face.

The next suggestion made was that regarding the steepness of the angle

formed by the mandibular lower border, the so-called mandibular plane angle. It was stated that if this angle exceeded a certain number of degrees the prognosis was extremely poor and that great difficulty would be encountered in attempting to correct the case. We began to hear about "good" faces and "bad" faces but actually no definitions were ever made that gave one the idea of what made up either a good face or a bad face. In those few cases where the attempt was made, the impression was left that only the face with a very straight profile and a prominent chin could be classed as desirable. All degrees of convexity were looked upon as undesirable and hence to be avoided in final results.

Faced with some of the obvious shortcomings of these extremely simple types of diagnosis, their authors were forced to establish in the place of absolute mean values a certain amount of range within which a deviation might be acceptable. Thus in the case of the lower central incisors a leeway of 5 degrees was given on both sides of the norm or mean and a similar leeway was allowed in the case of the mandibular plane angle. But even these allowances seemed to have their shortcomings and in spite of the fact that dental units were taken out there was little or no change in the ultimate results obtained.

Finally, only three years ago, Dr. Downs published his well known analysis of malocclusion. In this work he attempted to examine all of the various relationships that might affect the total physiognomy. Not only did he establish mean values but ranges and degrees of deviation that might be considered acceptable. This analysis of Downs is a return toward rational thinking but Downs would be the last one to claim its infallibility. He recognizes all too well that there are a number of other factors in the problem that cannot be

measured by any present means at our disposal.

Although devoted to a quite different purpose, the Wylie analysis of antero-posterior dysplasia is another attempt to diagnose malocclusion on the basis of morphology. Wylie recognizes that the pattern may be stable. This means that malocclusions that become apparent only with the change in dentition probably are traceable to some inherent discrepancy or dysplasia of the parts and his method is devoted purely to determining the site or sites of such disproportion. This is really a search in the field of etiology.

At the present time there are two schools of thought in the matter of diagnosis. There are those who still cling to the esthetic standpoint, who still attempt to treat all their cases to an upright relation of the incisors and, so far as possible, to straight faces. They are finding, however, that even in those cases where there is ample room in the arch following extraction such things as crumpled incisors are apt to recur because of some reason other than crowding. They are also finding difficulty in maintaining contact at the site of the extraction and they are almost invariably having difficulty in maintaining a reduced overbite. Finally, they are failing to produce the beautiful, occlusal interdigitation that was so characteristic of a well treated case in the days before extraction. The other school is continuing to seek standards and guides of a quantitative nature. Their standards and norms are of necessity morphological in nature thus far. A great deal of material of this sort has been accumulated during these past ten years and it is becoming difficult to find a problem in morphology that has not been investigated.

Parallel with these two types of activity another has come into view these past several years. I refer to the con-

cept that has arisen from efforts to guide the denture through the critical mixed dentition stage. Some of the observations being made here are so completely contrary to both the concepts and the findings of the past as to force the realization that we must reexamine some of our cherished beliefs. This work is indicating that it requires, in some cases at least, only the liberation from natural functional forces to lead to a normal development of the dental arch. The ideas that the arch cannot be lengthened or that it cannot be widened, that a blocked-out canine can never be accommodated except by the extraction of a tooth adjacent to it, no longer go unchallenged. All of these things have been done, not once but many times, and they are making us realize that we must conduct research in fields other than that of morphology if we ever expect to make diagnosis exact enough to permit accurate prognosis.

We have great need to know more

about the potential of growth of the individuals whom we treat. We have need to know more about the adjustment that is inherent in muscle tissue. We have need to know whether, by changing the dental arches, we bring about compensatory adjustments of that musculature and just what limits exist to such adjustments. I do not intend to speak about these things further at this time since I have another paper to give this afternoon on the subject of musculature, but I should like to conclude this talk by pointing out that the field of diagnosis has changed repeatedly over the years; that it has been based successively on standards of esthetics, of function and of morphology. None of these has proven complete unto itself and the more we study and the more we learn, the more we realize that an adequate diagnosis must embrace not only everything we can gain from each one of these fields but also from a correlation or a synthesis of the items gained from each.

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