

THE DIAGNOSTIC SETUP WITH CONSIDERATION OF THE THIRD DIMENSION

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PLASTER casts have long been in use for the analysis and treatment planning of all orthodontic cases. Although they have been considered study casts, much of the study has been merely speculation as to what might be accomplished orthodontically. Diagnosis through rearrangement of the plaster teeth was overlooked. Good orthodontic casts not only provide exact duplicates of every tooth in the mouth, but they also give a fairly accurate pattern of the apical base. Since neither apical base nor tooth size can be altered materially, intelligent rearrangement of the plaster teeth on the model can replace the confusion of speculation with concrete objective manipulation. An orthodontist armed with such vital information of these basic factors of any orthodontic case can certainly approach the problems of treatment with more confidence. Without dissecting the teeth from the orthodontic models and rearranging them in the most desirable positions on the available apical bases, the orthodontist can only speculate as to the possibilities and limitations of treatment.

About ten years ago, while developing the tooth positioner, we found it necessary to make many such setups, dissecting the teeth from plaster models and rearranging them in wax in more desirable relationships. The experience of constructing these setups for cases just completing basic treatment leads us to believe that much benefit could be derived from the preparation of similar setups constructed from the original models prior to undertaking treatment. The idea of such a diagnostic setup was shelved for a few years, as all available time was devoted to perfecting the tooth positioner, and it was not until 1946 that we made our first attempt to teach the technique to a class.

Since 1940, I have followed the Tweed philosophy of treatment. Therefore, from the beginning of the experiments, an effort was made to position the teeth in accordance with this philosophy. In the earliest diagnostic setups, the angulation of the teeth was only estimated. The mandibular anterior teeth were patient. Following Tweed's¹ presentation of his ideas with regard to the Frankfort-mandibular plane angle, published in the *AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY*, we revised our technique to conform to these refinements. The formula developed at that time was not scientific, but it proved to be practical clinically. Referring to Fig. 1, the long axis of the mandibular incisor was set at 90 degrees to the mandibular plane in those cases having a 25 degree Frankfort-mandibular plane angle (FMPA). As the FMPA in-

¹Presented before the Charles H. Tweed Foundation for Orthodontic Research, Drake Hotel, Chicago, Illinois, Oct. 31, 1953.

creased by 1 degree, the incisor was set 1 degree to the lingual, or 89 degrees to the mandibular plane. This ratio was maintained until the angle reached about 33 degrees, at which point the incisor would be placed at -8 degrees, or 82 degrees to the mandibular plane. As the FMPA exceeded 33 degrees, the -8 degrees was maintained, because it was our conviction that -8 degrees was the maximum lingual position possible for an incisor. Similar limitations were observed in the labial positioning, using +5 as the maximum labial position, regardless of how favorable the FMPA might be.

FMPA 20°	=	+5 IMA
FMPA 21°	=	4 IMA
FMPA 22°	=	3 IMA
FMPA 23°	=	2 IMA
FMPA 24°	=	1 IMA
FMPA 25°	=	0 IMA
FMPA 26°	=	-1 IMA
FMPA 27°	=	-2 IMA
FMPA 28°	=	-3 IMA
FMPA 29°	=	-4 IMA
FMPA 30°	=	-5 IMA
FMPA 31°	=	-6 IMA
FMPA 32°	=	-7 IMA
FMPA 33°	=	-8 IMA

Fig. 1.—Formula for positioning lower anterior teeth.

When Tweed² demonstrated the use of the lateral head x-ray to determine the angulation of teeth, the diagnostic setup became much more accurate. A tracing made from a lateral head x-ray of any orthodontic case would show definitely the relationship of the mandibular incisor to the mandibular plane. Thus, we can eliminate the guesswork from the positioning of this tooth. Since we begin the diagnostic setup in all cases with the positioning of the lower incisor, it is very important to know the angulation of this tooth in the malocclusion. Using the formula developed in the past, the desired position can also be drawn on the tracing (Fig. 4). By a comparison of these two lines on the tracing, it is possible to determine the exact measurement, in millimeters, that the incisal edge must be changed. In altering the angulation of the incisor, care must be taken to maintain the apical root end in the apical base. As treatment progresses, similar x-ray films can show the new angulations of the incisors. Cases have been reported where these teeth have been moved as much as 25 degrees. For this reason, our formula was expanded to allow for considerably more latitude in lingual positioning.

For the benefit of those readers who may be unfamiliar with the technique of constructing a setup, let us consider those things which are necessary for its preparation. Plaster casts of the malocclusion (Fig. 2), instruments (Fig. 3), intraoral x-ray films, a photograph of the patient, and a tracing of a lateral head x-ray (Fig. 4) are included. On the tracing of the lateral head x-ray shown, the Frankfort plane is indicated by line *A-B*, the mandibular plane by *A-C*, the long axis of the mandibular incisor by *C-B*, and the apex by *D*. The desired position of the long axis of the incisor is *D-E*. In this particular case, the FMPA is 27 degrees, the incisor-mandibular plane angle (IMPA) is 102 de-

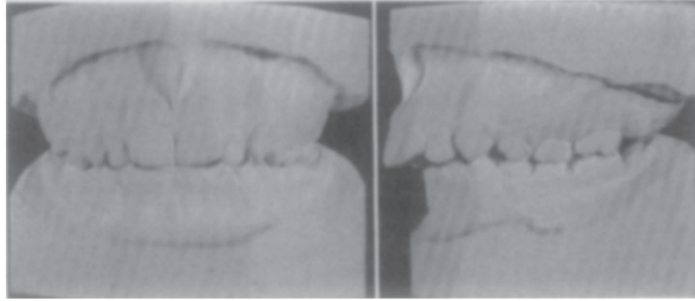


Fig. 2.—Plaster casts of malocclusion.

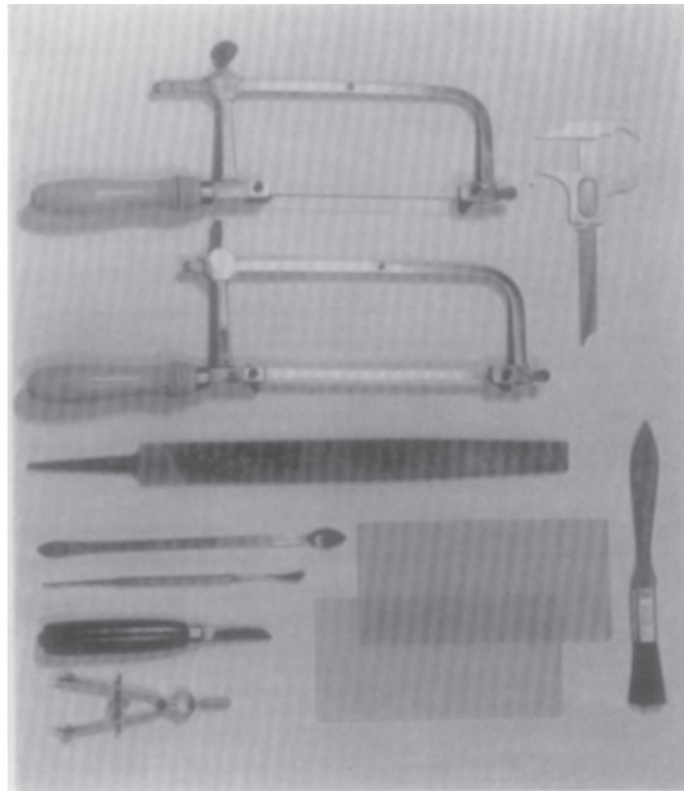


Fig. 3.—Instruments required for the execution of the diagnostic setup.

degrees, and the Frankfort-mandibular incisor angle (FMIA) is 51 degrees. With a 27 degree FMPA, our formula indicates that this tooth should be positioned at -2 degrees, or 88 degrees. This is 14 degrees different from the 102 degrees shown on the tracing. Therefore, the dotted line, *D-E*, is drawn from the apex of the mandibular incisor to the Frankfort plane, 14 degrees lingual to *C-B*, the original position of the tooth. With calipers, or a millimeter gauge, the distance from the tip of the incisor to the dotted line can be measured. This is the distance that the tooth must be tipped to the lingual on the setup.

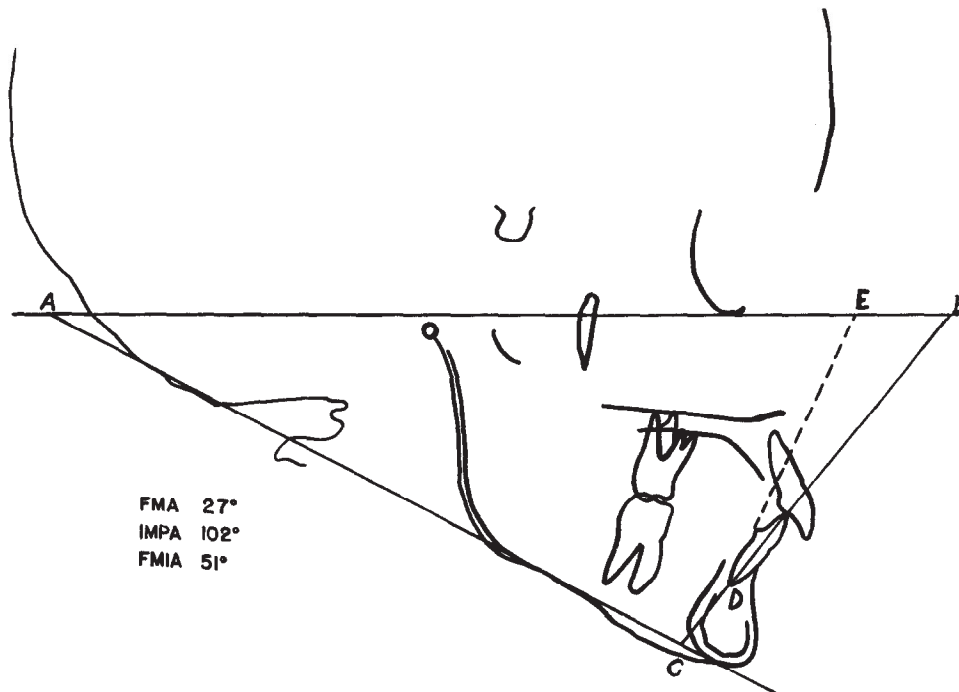


Fig. 4.—Tracing of the lateral head x-ray.

Now we are ready to begin the actual construction. First, we propose to dissect and remove the teeth on the left side of the mandibular model, leaving only the most distal tooth. With a spiral plaster saw blade, a horizontal cut is made deep into the base of the model. Using a ribbon saw blade, vertical cuts are made between the incisors down to the original horizontal cut, allowing two incisors to be removed (Fig. 5). It is very important that a sufficient amount of the root portion be removed to resemble the normal length of the root. The incisors on the opposite side are retained on the model, for the time being, to serve as a guide for repositioning the teeth previously removed. A second horizontal cut is made with the spiral saw blade about 3 mm. rootwise from their gingiva under the remaining teeth to be removed on the left side. The models should be trimmed as shown in Fig. 6. The teeth should be carved as shown in Fig. 7. Note that the teeth are not trimmed on the buccal or lingual surfaces.

In preparation for positioning the teeth, we flow beeswax into the groove carved on the apical base. Then a small amount of beeswax is attached to the apical end of the central and lateral incisors, and they are positioned on the



Fig. 5.—Mandibular model showing horizontal and anterior vertical saw cuts.

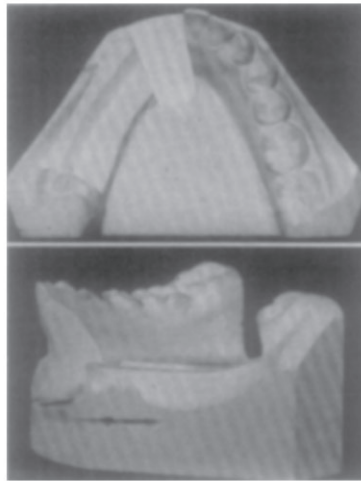


Fig. 6.—Mandibular model, trimmed, after removal of the teeth on left side.

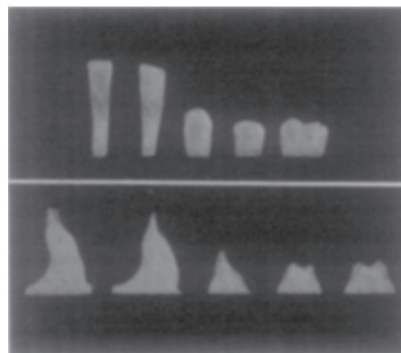


Fig. 7.—Labial, buccal, and mesial views of teeth trimmed for diagnostic setup.

cast. In carrying out this step of the procedure, it is essential that the apices of the teeth should not be shifted to the labial or lingual, while the incisal edges must be moved exactly the distance determined on the tracing, in this

case 6.8 mm. This goal can best be accomplished by keeping the labial art portion of these teeth in the same plane as that of the remaining art portion of the model and, with the calipers, measuring from the labial side of the right central incisor to the labial side of the left central incisor and making this space 6.8 mm. When the central and lateral incisors are repositioned, and are in proper axial inclination, we seal them onto the cast with red setup wax. Then we position the canine in proper relationship with the lateral incisor and the apical base, securing it with a small amount of beeswax. Similarly, we position the remaining dissected teeth. In studying the x-ray pictures and models of the case at hand, if it is evident that the distal molar is tipped forward because of

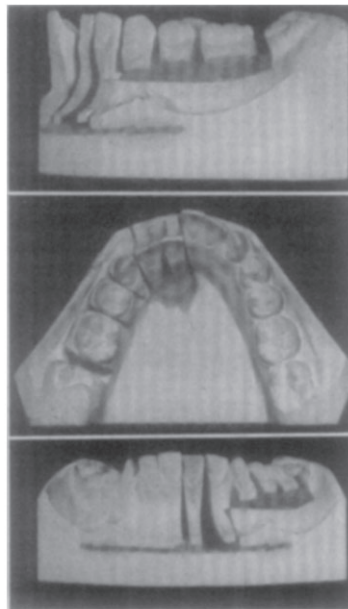


Fig. 8.—Views of mandibular model with teeth on left side repositioned.

lack of mesial support, it is possible to gain space by tipping the tooth into normal axial inclination. If space is still lacking after taking advantage of this possibility, it will be necessary to remove dental units. In such a case, ordinarily the first premolars are eliminated, after which the second premolar is moved up into contact with the canine. Under no circumstances should arch length be gained by increasing the third dimension, or arch width, greater than the apical base can accommodate. The amount of unused space after the teeth are positioned, if any, is a very important guide in treatment planning. The anchorage problem increases as this space decreases. (Fig. 8)

The teeth on the opposite side are now dissected 3 mm. below the gingival margin, including the incisors, and the root portions are trimmed as before.

The teeth are positioned the same as those on the left side, eliminating the same dental units, if necessary (Fig. 9).

The procedure with the maxillary model is undertaken with a spiral saw cut horizontally (Fig. 10). Vertical saw cuts are made with a ribbon saw blade through the interproximal teeth. The teeth are removed and trimmed on the mesial and distal root surfaces before being replaced on the cast in soft beeswax.

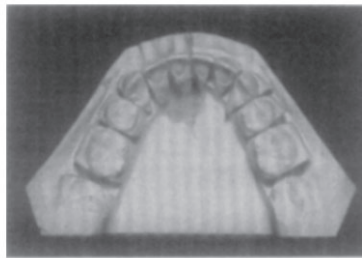


Fig. 9.—Occlusal view of mandibular model with first premolars eliminated and teeth positioned.

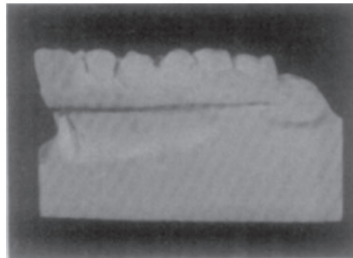


Fig. 10.—Maxillary model showing horizontal saw cut.

As they are positioned, they should be articulated to the mandibular teeth. At this time, the orthodontist has an opportunity to position the teeth in the very best occlusion, including inclined plane relationship. Tooth discrepancies may be discovered and given early consideration in treatment planning.

In cases where the second molars are fully erupted, they should be removed from the casts and placed in contact with the first molars and in good occlusion. If they are not fully erupted, impressilons of these teeth can be made in the mouth at the end of basic treatment and plaster models of these teeth made which can be added to the setup at that time. Having the second molars in place is essential, particularly if the setup is to be used as a pattern over which a positioner is to be fabricated for the final detailed tooth positioning.

The final waxing of the setup is completed, using pink setup wax for this part of the technique. With a hot spatula, we flow pink wax between the root portions of the teeth, slightly overfilling all the voids on the buccal, labial, and lingual areas of the model. After the wax has hardened, it should be carved to reproduce exactly the gingival areas around the teeth (Fig. 11). If this is successfully accomplished, there will be no irritation from wearing a positioner.

A carefully executed setup, following the above technique, will aid any operator tremendously in making decisions with regard to the advisability of eliminating dental units. As the plaster teeth are placed on the plaster apical base, we have concrete evidence as to whether or not there is sufficient basal bone to accommodate all the teeth in proper position. There is no system of measurement of teeth that will reveal so true and complete a picture. Unusual benefit

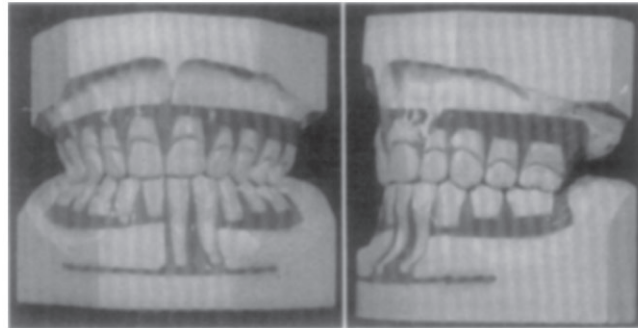


Fig. 11.—Front and lateral views of completed setup.



Fig. 12.—Tooth positioner.

is to be derived from the fact that in this way all three dimensions of the denture may be studied. The setup will disclose tooth discrepancies, as well as give advance notice of anchorage problems and it provides a pattern over which to fabricate ideal arch wires during treatment. With such a complete setup, a positioner can be prepared in advance so that it can be placed on the day conventional appliances are removed (Fig. 12). Great advantage is gained by placing a positioner immediately. Finally, the diagnostic setup is particularly valuable in teaching “youngsters” who are unfamiliar with the Tweed philosophy of treatment and, if intelligently executed, some of the “oldsters” might be amazed by the benefits to be derived.

REFERENCES

1. Tweed, C. H.: Frankfort-Mandibular Plane Angle in Orthodontic Diagnosis, Classification, Treatment Planning and Prognosis, AM. J. ORTHODONTICS AND ORAL SURG. **32**: 175-230, 1946.
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