Cephalometric Observations In Class II, Division I Malocclusions Treated With The Activator

P. FREUNTHALLER, Dr. Med.

Vienna, Austria

The activator is generally used in Vienna for the treatment of Class II, Division I malocclusion and it has given very good results during the last twenty-five years in thousands of cases. This appliance is selected because it may produce changes in the region of the mandibular joint and its surrounding bone or influence the growth of the mandible favourably. The activator seems, therefore, especially indicated in Class II malocclusions with distinct mandibular retrusion. This simple appliance which was used originally by Robin[1] in 1902 has been modified and improved by Andresen, Häupl, Petrik and others.[2] Petrik was the first to demonstrate that it is possible to correct a full cusp distoclusion with this appliance.

Although in the majority of instances satisfactory correction of Class II malocclusion has been obtained with marked improvement in facial and dental features, others, receiving the same treatment, did not show the desired effect.

The question whether activator treatment is able to produce the change from distoclusion into neutroclusion mainly by changes in the joint area (as supported by investigations of authors in Central Europe) or whether a combination of tooth movement, growth and other factors occurs, is still open to discussion and may remain unsolved for many more years.

The present paper deals with a cephalometric analysis of treatment results of Class II, Division I malocclusion obtained with the activator.

MATERIALS AND METHODS

The material for this investigation consisted of 35 cephalograms (18 girls and 17 boys, not younger than 9 and not older than 15 years), with retrognathic mandibles as confirmed by examination of the headplates. All patients had a typical Class II malocclusion, deep overbite and protrusion of maxillary incisors. Treatment was accomplished with practically the same type of activator. Distal movement of molars to retrieve space, loss for unerupted or malpositioned premolars, as well as extraction cases, were not included in the material examined.

All patients showed a complete correction of the distal arch relationship, adequate raising and correction of the maxillary incisor protrusion. In short, the sample selected consisted of excellent treatment results, although the profiles of several patients showed disappointingly little improvement. It was of particular interest to examine the records of those individuals for whom a change in the profile configuration was not achieved as a result of the therapy. The head films of every patient, obtained at annual intervals and at the end of treatment, were analyzed using the system of Schwarz.[3] This method, used routinely in all orthodontic clinics in Vienna, avoids difficulties relevant in the selecting of planes, points or curves for superposition. Measurements are made directly on the film.

In 1936, Schwarz[3] demonstrated that a normal denture can be situated in different ways within the skull. Measurements defining the jaws or the positions of teeth should not be appraised in terms of their relationship to distant landmarks or reference lines in the cranial base. In agreement with Korkhaus,[4] Schwarz divided the cephalometric analysis into two parts, namely:

1) *Craniometrics* = measurements of the facial skeleton.
2) *Gnathometrics* = measurements of the jaw bones and dentoalveolar structures, or those parts of the face below a line from anterior to posterior nasal spines.

This system contains twenty-two measurements on each film but only some of the most relevant and unfamiliar ones to orthodontists accustomed to other systems will be mentioned as shown in Figure 1: F—Facial angle, sella, nasion, point A; J—Inclination angle, angle formed by perpendicular to N-Se and spinal plane (spin. nas. ant. to spin. nas. post.); B—Basis angle, angle formed by spinal plane and lower margin of mandible; and MM—Maxillomandibular angle, angle formed by spinal plane and a line connecting points A and pogonion.

Schwarz[3] stated that the maxillomandibular angle serves to define the sagittal relations of the anterior aspects of the maxilla and mandible. The value of this angle is 90° (± 2°) and it decreases or increases according to amount of change in the basis angle (B) in each individual. Clinical experience revealed that a relation of 10 : 7 was apt to correct mathematically the influence of a high or low basis angle on the maxillomandibular angle.

To explain the importance of this maxillomandibular angle (*MM*), Schwarz demonstrated the tracings of head plates of a Class II, Division I malocclusion. The boy was ordered to move his mandible forward into Class I position. The tracings with the dental arches in distoclusion were superposed on the one obtained when the boy moved his mandible ventrally, using all corresponding bony contours of the cranium and maxilla for superposition. The results of this experiment are

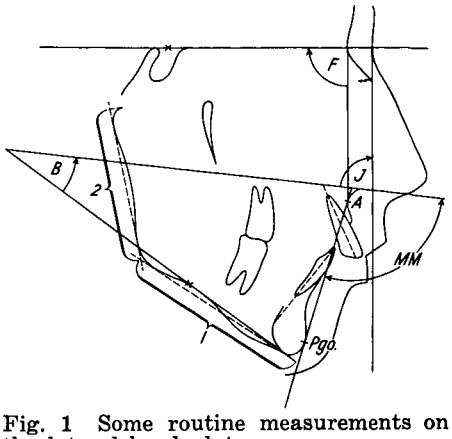

Fig. 1 Some routine measurements on the lateral head plates.

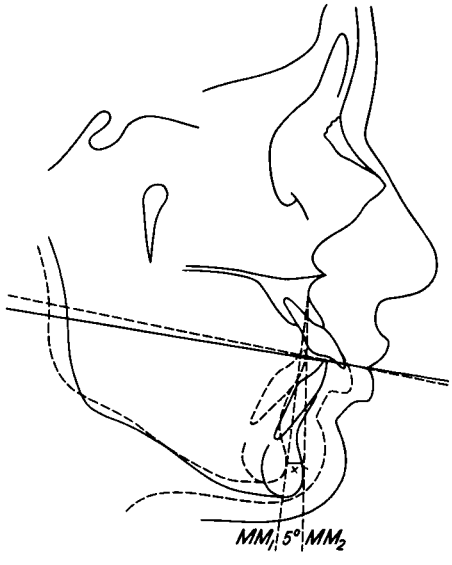

Fig. 2 Tracings of a ten year-old boy with Class II, Division I occlusion.
— — — — — in centric occlusion.
——— mandible moved forward into Class I occlusion (Change of maxillomandibular angle = 5°).

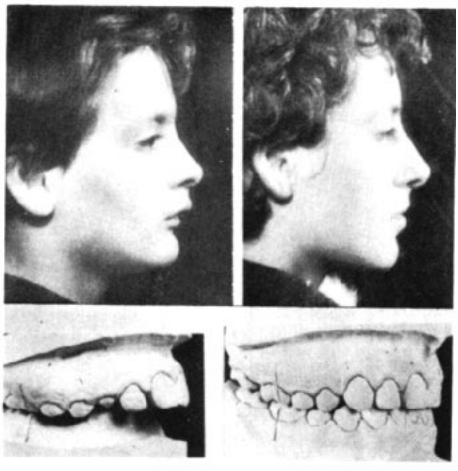

Fig. 3 Girl, nine years old at start of activator treatment and thirteen years at the end of retention period. Photos and corresponding models.

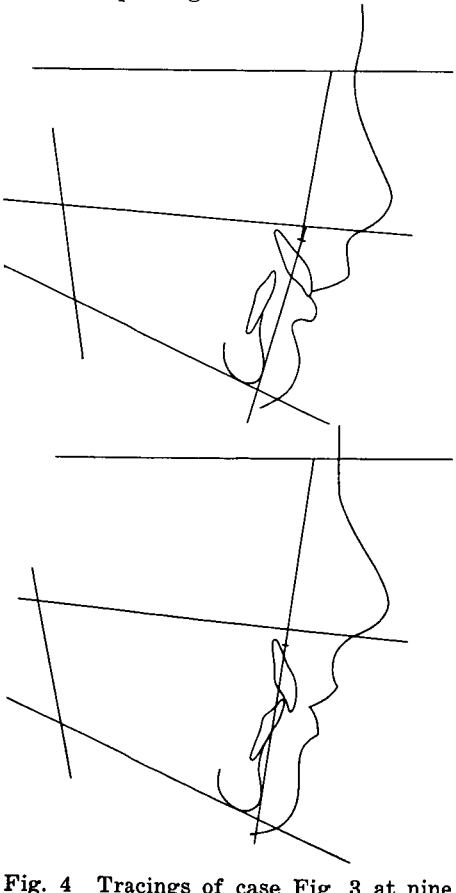

Fig. 4 Tracings of case Fig. 3 at nine years and at thirteen.

shown in Figure 2 which demonstrates also that the change in the angle *MM* is about five degrees between Class I and Class II positions of the mandible. This finding indicates that a forward development of pogonion corresponding to a five degree change in the angle *MM* would be sufficient to correct a full cusp Class II intercuspidation. In general, superposition was not used except in some instances as in Figures 2, 5 and 7 to illustrate the findings.

Findings and Discussion

In the area which was far away from the influence of appliance therapy, little change in angular measurements was found. The angle of the cranial base (NS) to the spinal plane did not differ to any remarkable amount, but linear distances increased as expected as a result of growth. Angles and linear relationships below the spinal plane changed considerably, because in this area appliances are effective.

Before considering the over-all findings, it seems practical to compare patients who showed improvement of facial esthetics to those who showed little or no improvement of facial contours during the years of treatment. Figure 3 shows distinct improvement of mandibular retrusion in the profile, evident also in Figure 4. Marked development of pogonion during the years of growth and treatment is illustrated in Figure 5, while reduction of the angle *MM* is also evident. In the second patient (Figure 6) practically no ventral development of pogonion occurred and the chin was still receded. Only bite raising or vertical growth (Figure 7) was noticed, combined with alveolar changes following the correction of tooth position, and the maxillo-mandibular angle did not change.

Regarding these two different responses to treatment, the following questions arise:

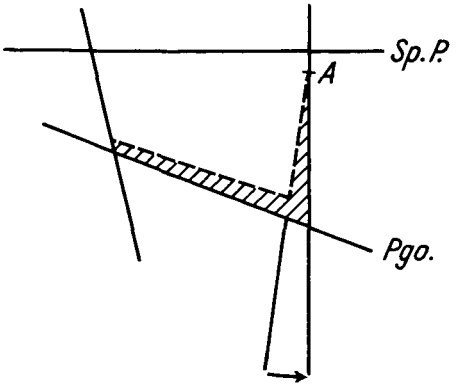

Fig. 5 Some details of the tracings of Fig. 3. Superposition on spinal plane and sagittal curve of palate (Korkhaus) reveals little change in point A but distinct forward and downward development of the mandible. Reduction of the angle MM is evident.

1) What is the most frequent reaction to activator treatment?
2) What changes generally accompany reduction of the angle MM?
3) Are the changes related to growth, the age at which treatment is undertaken, or a combination of these factors?
4) What kind of facial configurations respond to treatment?
5) Can the result of activator treatment be predicted in individual instances?

The graph shown in Figure 8 shows that the angle *MM* showed a distinct tendency to decrease during treatment, with changes ranging between 0 and —5 degrees in the greatest number of instances (5 degrees are sufficient to bring along full correction of Class II intercuspidation as shown in Figure 4). In the absence of material to judge the behavior of this angle during growth of

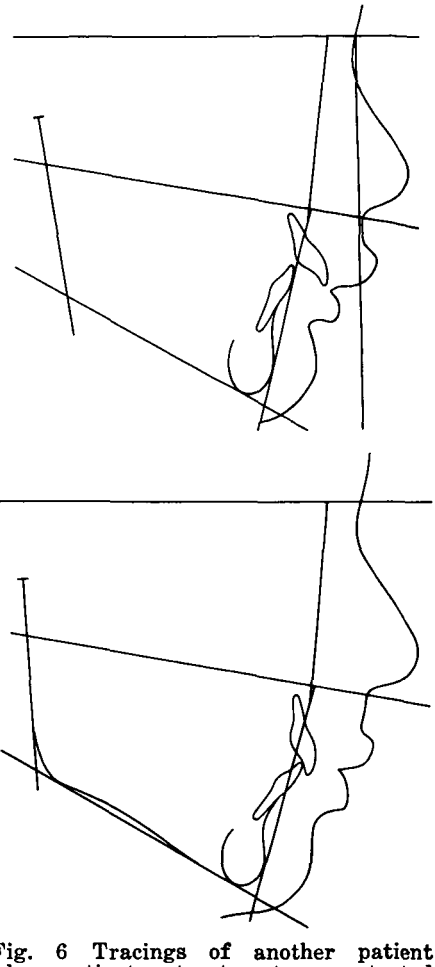

Fig. 6 Tracings of another patient when activator treatment was started and at end of treatment. Correction of malocclusion but poor esthetic improvement of profile. Age and treatment time are almost corresponding in the cases of Figures 3 and 6.

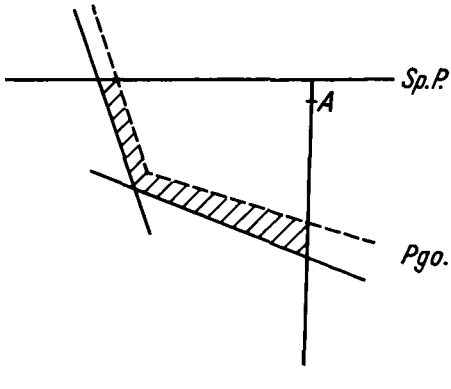

Fig. 7 Superposition (according to Fig. 5) shows missing forward development of the mandible. Practically no change of the angle MM but considerable vertical development.

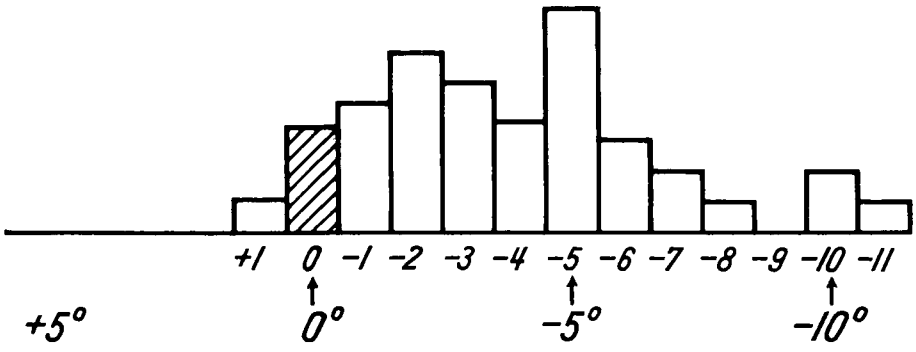

Fig. 8 Changes of the maxillomandibular angle in 35 Class II cases successfully treated with activators.

"normal" individuals, the following conclusion can be made with all necessary caution, namely: that during the treatment with activators a forward development of the mandible probably occurs. The amount of growth cannot be attributed to growth changes that also occur in untreated patients, since Fröhlich[4] found that in untreated Class II malocclusions the sagittal relations do not improve with age. In individuals treated with activators this forward development in relation to the maxillary base was combined with alveolar changes (changes in tooth position, etc.) and bite raising, that do not occur to the same extent in untreated Class II malocclusions. In some instances correction of distoclusion was largely confined to alveolar changes and sometimes distinct changes were observed in the skeletal pattern that led to improvement of facial esthetics. Yet, in practically all patients a combination occurred of alveolar changes, expressed by means of dental landmarks compared to other dental landmarks or bony landmarks, as well as a more or less distinct change in the relation of purely bone landmarks.

Skeletal changes were quite sufficient in about forty per cent of the subjects to bring along correction of a full Class II intercuspidation, as can be noted from Figure 8. Almost ten per cent of the patients showed mandibular growth to an amount twice sufficient for correction of a full cusp distoclusion with a reduction of the angle *MM* of ten degrees or more. In about sixty per cent of the material, insufficient growth of the mandible was found and in more than ten per cent it was completely missing, as noted by a lack of reduction of the angle *MM*, while in some subjects this angle even increased.

Alveolar changes, together with correction of frontal protrusion and bite raising, were invariably observed. When little or no mandibular growth occurred, increased alveolar movement of buccal teeth was noted bringing correction of Class II intercuspidation by means of alveolar distal movement of upper teeth and mesial movement of lower buccal teeth.

Statistical evaluation revealed that the decrease of the maxillomandibular angle was accompanied by growth of the mandibular body, which implies that individuals with marked decrease of the angle *MM* showed also marked growth of the mandible. The increase of the distance I (Figure 1) and the decrease of the angle *MM* were correlated ($r = -0.64$, $t = -4.4$), but less marked was the correlation between the increase in the length of the ramus (distance 2 in Figure 1) and the change of the angle *MM*.

Clinical experience has indicated that improvement of facial esthetics is linked to favourable growth trends. It seems probable that functional orthopedics by means of activator treatment has a stimulating effect on the growth centers and sites. American authors are also aware of the importance of growth for the success of orthodontic therapy. Moorrees[5] demonstrated treatment results analyzed with the mesh diagram. In a case of Class II, Division I malocclusion that was corrected in thirteen months he found that "apart from small changes in the position of the maxillary incisors and the condyle, treatment owes its favourable outcome to the increment in the length of the mandibular body, that exceeded growth in the depth of the skull base and upper face."

Longitudinal growth of the mandibular body enhances an improvement in the sagittal malrelations of the basal bones during activator treatment. Adaptive alterations in the region of the temporomandibular joint and in the condylar growth center may effect a more forward position of the whole mandible. In standardized lateral head radiographs, the region of the joint and condyle are seldom clearly visible which precludes detailed analysis. Changes in the joint area and condyle during activator treatment have been described by Häupl and Andresen,[2] Hausser [6], Korkhaus,[4] Schwarz,[3] and others. These changes may precede alveolar adaptations, correcting distoclusion in a few months and leaving lateral open-bites. Such lack of synchronisation in adaptive changes was, however, not found in the present study.

Although correlations between growth of the mandible and correction of mandibular retrusion were observed, no significant differences in response of various age groups occurred. This finding was not surprising, because the majority of patients were between nine and ten years old when treatment started. Other authors have demonstrated that younger children, during the same time and treatment, had more forward growth and older ones, more vertical growth.[6,7,8] On the basis of this observation, which incidently has many exceptions in our material, we have adopted for years the policy of starting treatment in the mixed dentition, especially in the case of underdevelopment of the mandibular base and retrusion of the denture. This timing allows maximal opportunity to profit from growth changes. It may result in longer treatment time, but this fact is not so important because the activator method is simple and does not require great efforts from the patients, once they become used to wearing the appliance at night. Girls, who reach their growth spurts sooner than boys, are treated rather early.

Jaw bones and dentures, even in normal development, may be situated in various ways in the skull, as stated in 1936 by Schwarz[3] who demonstrated several different facial types in association with normal occlusion. Yet high base angles, elongation of the lower third of the face, and high position of the joint are unfavourable factors in Class II treatment, a fact Korkhaus[9] has recently noted. Mandibular retrusion is certainly more evident when associated with lack of chin prominence. Shape of chin, frontal bones and nose also play an important role. Salzmann[10] has stressed the importance of the shape of the nose, demonstrating a case where surgical intervention on the nose was sufficient to make the chin appear less receding.

The factors mentioned, and others, may be combined in different ways in the individual Class II case. All subjects examined had a more or less distinct mandibular retrusion and rather high

MM angles. It was therefore obvious that growth of the mandible was necessary to attain the treatment objective, rather than extraction of maxillary premolars, or distal movement of maxillary posterior teeth.

If attempts are made to induce forward development of the mandible through appliance therapy, the effect on the profile will depend on the direction of the change of the chin. Preference is given to forward rather than downward changes because it may be remembered that excessive bite raising will reduce the desired effect on the profile. The inclinations of the maxillary base and occlusal plane are also important factors which may determine whether a favorable change in the profile can be achieved. Therefore, appraisal of facial pattern may give us some idea about the outcome of therapy. Yet, in the presence of favourable facial patterns, prediction of the response to treatment on the individual patient was not satisfactory and no explanation was found why some of the subjects showed mostly alveolar changes and little forward growth of the mandible.

The treatment records of thirty-five patients afforded a limited possibility to assess a four-year developmental period in each single instance. Several characteristics mentioned in the literature have been tested in this material as possible signs of favourable growth tendencies. It is evident that the mandible is the most important factor for improving facial morphology. Ricketts[11] has drawn attention to the gonial angle, the width of ramus, the symphysis, the thickness and inclination of the condyle head, corpus and ramus length, and the antegonial notch because they may be important characteristics for future growth tendencies. In our small sample it could be noticed that they may give some idea about the direction of growth, but not infallible clues, for predicting what actually will occur in the individual child during treatment. The amount of growth and change of facial pattern are rather difficult to predict. The amount of growth of the mandible is sometimes disappointing and alveolar changes and vertical development may prevail, even when most of the characteristics point to a favourable development. Accurate prognosis is therefore difficult and requires continued investigation on a much larger scale.

Summary

Records of thirty-five patients with Class II, Division I malocclusion and mandibular retrusion have been examined cephalometrically before, during and after treatment with activators, Alveolar changes, growth and forward movement of the entire mandible were found in several combinations to account for correction of the malocclusion.

Währinger Strasse 23A

References

1. Robin, P.: Observation sur un nouvel appareil de redressement. Rev. Stomatol. Vol. 9, 1902.
2. Andresen, V., Häupl, K. Petrik, L.: *Funktionskieferorthopädie* ed. 5, München, J. A. Barth, 1957.
3. Schwarz, A. M.: Lehrgang der Gebißregelung Wien, Innsbruck, Urban u. Schwarzenberg Vol I and II, 1956.
4. Korkhaus, G.: Present orthodontic thought in Germany, *Am. J. Ortho.*, 45:881-900, 1959.
   ————: Die Auswertung des Fernröntgenbildes Deutsche Zahn,- Mund- u. Kieferheilkunde 3:715, 1936.
5. Fröhlich, F. J.: Changes in untreated Class II type malocclusions, *Angle Ortho.*, 32:167, 1962.
6. Moorrees, C. F. A. and Lebret, L.: The mesh diagram and cephalometrics, *Angle Ortho.* 32:214, 1962.
7. Hausser, E.: Ergebnis der Distalbißbehandlung am Fernröntgenbild. *Fortschr. d. Kieferorthop.* 22:186, 1961.

———: Wachstum und Entwicklung unter dem Einfluß funktionskieferorthopädischer Therapie. *Fortschr. d. Kieferorthop.* 24:310, 1963.

8. Madsen, E.: Untersuchungen über das Verhältnis des Unterkiefers zum Gesichtsschädel. *Fortschr. d. Kieferorthop.* 23:255, 1962.
9. Korkhaus, G.: Das Kinnproblem in kieferorthop. Sicht. *Fortschr. d. Kieferorthop.* 25, 2:153-164, 1964.
10. Salzmann, J. A.: *Orthodontic principles and prevention.* Phil., Lippincott Co., 1950.
11. Ricketts, R. M.: Cephalometric synthesis, *Am. J. Ortho.*, 46:648-673, 1960.