Orthodontic treatment in the mixed dentition

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Orthodontists today treat patients more effectively, in a shorter period of time, and with more stable results than ever before. However, a shortage of orthodontists still exists the world over,¹ so our treatment must be streamlined to serve the greatest number of persons without sacrificing the quality of the result.

Contemporary orthodontics has many ways of reaching its objectives, and there are numerous variations in current orthodontic treatment. Orthodontists differ greatly with respect to philosophy and treatment methods. In the last decade the controversy has become more vehement. The range is wide, and there are advocates of innumerable techniques. These include removable and fixed appliances, heavy wires, light wires, heavy forces, light forces, and different types of brackets. In the edgewise technique alone, there are such variations as the use of the 0.016 inch or 0.018 inch bracket versus the standard 0.022 inch bracket. There is discord over whether root torque should be initiated early or late, whether or not tip-backs should be used, and the type of extraoral traction to be employed (cervical, occipital, or high-pull). We have variations of opinion as to how to resolve pernicious habits, when to start orthodontic procedures,² whether we should have short or long treatment periods, and whether we should divide treatment into two parts—the first consisting of growth supervision with simple appliances and the second involving banding and finishing of the case. The use of orthopedic versus orthodontic forces has also been a subject of debate.³

Orthodontics can be compared to the Grand Prix auto race. In the “Formula One” we have the Nadras, the Ferraris, the Fords, the Brahm Specials, the Hondas, etc., all fine machines with the best drivers. All could probably win the race, but only one car makes it. In orthodontics we have the

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finest equipment and professional training. We have to be good drivers, because we all have to "make it." Our responsibility is great, and we have little excuse for mistakes; yet orthodontics is so complex that it is difficult to be infallible. There are too many variables, such as genetic potential, patient cooperation, and other intangibles, which we cannot control. Young men just out of graduate school may have all the tools for proper orthodontic treatment; however, it is an undeniable fact that we learn from experience and from each other.

Dentistry has criticized orthodontics, often unfairly. Our achievements are accepted as natural, but we are attacked for unavoidable reactions that may not appear until several years after treatment has been completed. The periodontist and the general practitioner have commented on the occasional trauma caused by our treatment procedures. True, incorrectly planned treatment can stimulate a pathologic process, but our critics should be fair. Most malocclusions are already traumatic when first seen by the orthodontist.

The dentist and the periodontist do not always have the opportunity to evaluate the condition of the finished case before treatment, and they also have many failures in their own work. Moreover, most finished orthodontic cases show excellent dental health years after treatment. We agree that often there is too much gross movement of teeth, traumatizing the periodontium. We must go back and analyze our cases and not get so engrossed in new techniques and mechanics which facilitate or rapidly terminate treatment but which may have unfavorable long-term results. Treatment procedures should be gentle, effective, and continuous. The "round trip" given by some techniques is traumatic, and we have been warned of this by anatomists and other research workers. If we are to believe in one technique or another, we must go farther and evaluate our cases many years after treatment. Five years out of retention is an absolute minimum for rebound and normal posttreatment growth to express itself.

It is evident that poorly executed dental treatment can also cause more damage than would have occurred had the mouth been left untouched. An improperly contoured inlay can create havoc, starting degenerative processes and periodontal disease. This is also true occasionally in orthodontics, and it might have been better if some of our cases had been left untreated.

As an example, in 1949 we made a study of the Mexican Otomi Indians, one of the few remaining almost genetically pure tribes. This group was found to be nearly free of caries, with slight crowding of the lower incisors, very little periodontal involvement, and an amazing longevity of the masticatory apparatus. Quite a few of these Otomi Indians had a full complement of teeth, worn down to the gingiva, up to and beyond the age of 100 years (Fig. 1).

Proper diagnosis is paramount. The orthodontist must be informed of research, such as that of Björk and other investigators on the calcification of the sesamoid bone, hand maturation, and growth potential.

We cannot and should not belong to clans or cliques. As professional men, we must have open minds and not get emotionally involved in treatment methodology. We must be broad-minded and interest ourselves in other tech-
Fig. 1. Example of Otomi young and old dentitions.

There are European orthodontists who show good results in some of their cases, even though they have expanded the dental arches. In many instances, cases treated by the functional orthopedic procedures so popular in Europe show a distressing tendency to relapse. The mystique that function produces a more stable result because it purports to be more physiologic does not bear examination, because forces that are artificially induced by these appliances must ultimately be transmitted to the dentoalveolar structures. However, let us not forget that one of the basic factors is the genetic potential of each individual. There are instances in which the arches have naturally expanded 3 to 4 mm. without treatment. We can assume that growth will take place in a certain direction in 95 per cent of our patients, but even here we can be 100 per cent wrong! We do not know how much a patient will grow or how long his nose and chin will be. We seem to see more big noses in our practice, probably because of the Latin racial background of our patients (mostly Spanish, French, and Italian). We can be right most of the time, particularly in normal cases, but occasionally the growth readings fail, and this can be extremely distressing to both the patient and the orthodontist.

Variations in case diagnosis, especially on the basis of cephalometric analysis, sometimes confuse the clinical orthodontist. Measurements can be used from as many as ten to fifteen different authors who have written on the subject. It is true that cephalometry is important in its ability to analyze facial pattern. It gives us an inkling as to whether there is a good growth potential; however, it is much more valuable, in retrospect, to examine what has been accomplished during and after treatment.

Philosophy of treatment

The purpose of this article is to describe our philosophy of diagnostic procedures and clinical treatment in the correction of mixed-dentition irregularities. Our office is located in Mexico City. It is a two-man practice, and our patients are mainly Western and Eastern Europeans, Latin Americans, and native Mexicans. All types of malocclusion and a large number of mandibular prognathisms are found. Besides taking full records of all patients starting treatment, we see both parents in order that we may discern the genetic type, especially the size of the nose and chin. Each patient is studied
Fig. 2. A to D, Use of headgear and bumper. E, Use of bumper with full-banded appliance. F, Use of Kahn spur.

by both men in the practice and a tentative diagnosis is made. The patient is then re-examined for corroboration of the diagnosis. Before treatment, each patient is started on an educational program covering nutrition, dental hygiene, and orthodontic information. Mothers are required to be present.

The majority of malocclusions are best observed or treated in the mixed-dentition stages. Cases treated early are more stable and show less relapse than those treated in the adult dentition. For that reason, an attempt has been made to encourage physicians and dentists to refer patients at an early age, preferably from 7 to 9 years. If treatment is not yet indicated, these patients are then re-evaluated annually or semiannually so that treatment can be undertaken at the best possible time.

The pendulum has swung widely since 1950, when the author first started his orthodontic practice. The removal of teeth has diminished considerably. Initially, many cases appear to call for serial extraction, but the number of cases in which teeth are actually removed is relatively low, possibly because patients are seen at an earlier age and may be treated by simple mechanics while growth takes place, giving Nature a chance. Proper timing is of the greatest importance in the mixed dentition, whether for serial extraction or extraoral traction treatment. Pliny the Elder said that “everything must be done at its proper season.” In no other profession does one have the chance, month after month, to guide the growth of the child. Fig. 2 illustrates this use of cervical traction and a labial bumper.

Many mistakes can be made by the overeager orthodontist, pedodontist, or general dentist in serial extraction cases. These may seem simple, but
Fig. 3. Cephalometric procedure for assessing vertical measurements (A) and horizontal and angular measurements (B). Vertical measurements: I, Sella horizontal to palate; II, Sella horizontal to upper first molars and interocclusal height; III, Height of lower first molars; IV, Nasion to menton (anterior height); V, Sella to gonial intersection (posterior height). Horizontal measurements: A, Sella vertical to upper first molars; B, Sella vertical to lower first molars; C, Sella vertical to point A; D, Sella vertical to point B; E, Sella vertical to pogonion. Angular measurements: 1, Palate plane angle (on sella vertical); 2, Frankfort-mandibular plane angle; 3, Occlusal mandibular plane angle.
actually they require more knowledge, skill, and experience than many other orthodontic procedures that appear to be more complicated.\textsuperscript{10, 11}

I have initiated a research project on the posttreatment changes following orthodontic treatment, with emphasis on early mixed-dentition correction with the cervical extraoral appliance. A group of treated cases, many years out of retention, will be compared over a long period of time with a group of similar nontreated cases. According to recent studies,\textsuperscript{12-15} it is apparent that cervical traction produces a favorable skeletal change, but it is likely that this influence is diluted, neutralized, or dispersed by growth in the late teen years. Much depends on the genetic pattern and sex of the individual patient. What we would like to know is this: Are we pushing molars back, and how much? Do they stay back? Are we increasing vertical height, or is this a natural part of growth? If we temporarily increase vertical height and push the mandible backward and downward, does it recover in later years?

These cases are analyzed cephalometrically by superimposing on sella-nasion at sella and drawing a perpendicular on the Frankfort plane at sella. This is constant in all succeeding cephalograms. Vertical and horizontal landmarks are measured in millimeters, and correction is made for film enlargement.\textsuperscript{16, 17} To facilitate measurements, a translucent millimeter grid is placed on top of the cephalometric tracing. The grid paper is numbered by units of 10 mm., both horizontally and vertically.

Fig. 3, A shows the vertical measurements, in millimeters, to the palatal plane (I), to the distal cusps of the upper molars and also interocclusal height (II), to the distal cusps of the lower first molars, measured from the border of the mandible (III), from nasion to menton, showing anterior height (IV), and from sella to gonial intersection, giving posterior height (V).

Fig. 3, B demonstrates the method of assaying the horizontal measurements from the vertical line from sella at a right angle to the Frankfort plane and shows the distance to the distal surface of the upper first molars (A), the distance to the lower first molars (B), the distance to point A (C), the distance to point B (D), and the distance to pogonion (E). The angular measurements are the palatal plane angle, measured on the sella vertical line (I), positive numbers denoting that the palatal plane is being directed upward and negative numbers denoting downward direction, the Frankfort-mandibular plane angle (2), and the occlusal mandibular plane angle (3).

It is evident that in most Class II nonextraction cases in which there is a good facial pattern and a flat mandibular angle, teeth must be moved posteriorly as far as possible while an attempt is made to increase vertical height. We all know that these cases in which alveolar height is low have a great resistance to tooth movement and that more relapse occurs after treatment. It is in these cases that cervical traction is of the greatest assistance (Figs. 4 and 5).

Patient E. A., a boy 7 years 6 months of age, had a fully developed Class II, Division 1 malocclusion, an extreme overbite, narrow maxillary and mandibular arches, and slight crowding of the lower incisors with a very constricted lower arch and a narrow upper arch (Fig. 4). The lower arch was much more constricted. A tongue habit was also present. This was diagnosed as a nonextraction case because of the flat facial pattern and good genetic potential.
Fig. 4. Patient E. A., with low Frankfort-mandibular angle demonstrating good growth during headgear therapy. Compare with Fig. 5, A and B.
Fig. 5. Patient E. A. Facial changes and cephalometric appraisal after primary treatment.
Table I. Conventional cephalometric analysis

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<tr>
<td>Frankfort-mandibular angle</td>
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Treatment was executed exclusively with cervical extraoral anchorage and a lower labial bumper to push the lower lip away from the upper incisors. Upper incisors were later banded to start leveling off the occlusal plane. This treatment took 3 years and 4 months.

Analysis of this case according to the method shown in Fig. 3 reveals that the upper first molars were displaced vertically or grew downward 10 mm.; the lower first molars grew upward 1 mm. from the mandibular border; anterior face length increased 13 mm. as compared to 10 mm. in the posterior face height. Horizontally, the upper molar moved posteriorly 3 mm., while the lower molar moved anteriorly 4 mm. Point A moved anteriorly 1 mm., while point B moved anteriorly 7 mm. Interestingly enough, in spite of the cervical extraoral traction, the palate was raised to +3 degrees. It is evident that this patient benefited greatly from the use of cervical traction, showing a favorable orthopedic influence.

Fig. 5 shows the facial changes and cephalometric tracings after the mixed-dentition treatment of this case. Since the lower molar, measured from the mandibular plane, increased by 1 mm., it is logical to assume that the extrusion of the upper molar can be considered growth. The full-banded edgewise appliance will be used for final treatment. Results to date indicate complete correction of the Class II relationship, a much improved overbite and overjet, good arch form, and improved facial esthetics.

Cases in which facial pattern is poor must be treated with more caution, and occipital or high-pull extraoral traction should be utilized. We cannot influence a poor facial pattern and, since growth is genetically determined, it may be only slightly affected by treatment.

Treatment of Class I cases

In Class I mixed-dentition cases a differentiation must be made between severe arch-length discrepancy and moderate discrepancy. In other words, in most cases the decision for serial extraction should be made only after the size of unerupted teeth is determined, after the first premolars start to erupt, and after at least 1 year of growth observation verified by cephalometric analysis. If the growth potential is good, an attempt should be made to treat these cases at an early age without extraction. Sufficient arch length can be gained with a bumper on the lower arch and cervical traction to the upper arch. Even cases with a discrepancy of 4 mm. or more still have a chance if the growth potential is good.

Cases showing a greater arch-length discrepancy will generally become extraction cases. This is also true of double protrusions with poor facial patterns. In some cases, a utility arch is used with upper molar and incisor bands in
order to gain a minimal amount of arch length. This arch is constructed with a 0.016 by 0.016 inch wire bent gingivally distal to the anterior brackets on each side and mesial to the molar tubes to avoid distortion from occlusal forces.

If patients with Class I and Class II malocclusions have flat profiles and a slight amount of crowding, they can also be treated in the mixed dentition with cervical traction and a bumper. Class I cases with a poor facial pattern are best observed and left alone until it can be decided whether the removal of teeth will be necessary for comprehensive treatment.

**Treatment of Class II cases**

Treatment of Class II cases in the mixed dentition is generally started with either a cervical or occipital extraoral appliance, depending on skeletal type. If crowding is present, a lingual arch or bumper, reinforced by Class III elastics, may be utilized. Sometimes the same technique can also be used for Class III cases. An example of a Class II case is shown in Figs. 6 and 7.

Patient L. M., a 5-year-old girl, had an extreme Class II, Division 1 malocclusion with mandibular crowding of 3 mm., thumb-sucking and tongue habits, and a slight open-bite. Because of the extreme protrusion, cervical traction was started at the age of 6 years 3 months. Extraoral traction was continued for 3 years and 1 month. The patient is now ready for final treatment with the edgewise appliance, and it should be relatively simple to finish.

Fig. 7 shows that the cephalometric findings, as measured by the author, demonstrated good vertical growth; the greatest growth occurred at the gonial angle, where there was an increase of 10 mm. in the posterior face height as compared to 6 mm. in the anterior face height.

Anterior growth was excellent and, even though the patient wore the extraoral cervical traction conscientiously, the upper molar moved 2 mm. anteriorly while the mandible grew forward 10 mm., measured at pogonion. The palatal plane was depressed to -3, but the Frankfort-mandibular angle was reduced from 32 to 25 degrees. The occlusal angle increased from 16 to 18 degrees. The anteroposterior ratio increased by 7.1 per cent in the posterior face height, and excellent results have been obtained with extraoral cervical traction therapy in this case. No Class II elastics were used. It is evident that there has been great improvement in the upper protrusion, arch form, correction of the overbite and overjet, and facial esthetics.

Class II, Division 2 malocclusions must be carefully analyzed, since many of these cases exhibit strong muscular forces and rarely require tooth extraction. It also is virtually impossible to correct a Class II malocclusion after the pubertal growth spurt without resorting to the removal of teeth.

**Class II discrepancy cases**

These are the cases in which extractions are required because growth is not sufficient to accommodate all of the teeth properly in the dental arches. In the mixed-dentition Class II discrepancy cases, caution is indicated unless the discrepancy is so great that serial extraction is essential. Growth is observed until the appearance of the first premolars, at which time a final decision on extraction can be made according to the amount of growth that has occurred.

**Open- and close-bite cases**

Open-bites and close-bites are two of the most complex malocclusions. The open-bite is frequently the result of an abnormal skeletal-dental muscular pat-
Fig. 6. Patient L. M., treated with headgear in mixed dentition.
Fig. 7. Patient L. M. Facial changes and cephalometric appraisal after primary treatment. Compare with Fig. 6, A and B.
Table II. Conventional cephalometric analysis

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<tr>
<td>Holdaway line</td>
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Fig. 8. Patient J. G. Class II, Division 1 nonextraction case with deep overbite. Compare with Fig. 9, A and B.
tern with a complex etiology. Pernicious habits, such as thumb-sucking, tongue-thrusting, and muscular imbalance, are also responsible for open-bites. That is why orthodontists must study such cases carefully. These patients have poor coordination, with disturbed proprioceptive reflexes. The pedodontist also has a responsibility, since pernicious habits should be recognized and corrected at an early age. Whenever possible, restraining appliances should be avoided in the correction of pernicious habits. Patients should, instead, be referred to a speech therapist to break these habits and help restore normal facial and oral muscular functions. This will also deter relapses during retention.

Patient J. G., a 9-year-old boy, had a Class II, Division 1 extreme overbite, a slight double protrusion, a small nose, and a nice face. The lower left second deciduous molar was ankylosed, and this delayed treatment considerably. There was no discrepancy in the lower arch, but there was slight spacing of the mandibular incisors. This patient was treated on a nonextraction basis with cervical anchorage and the edgewise appliance.

The last cephalogram was taken when the patient was 20 years 2 months of age. No cephalogram was taken at the end of treatment because the patient had left for school in another country. The changes which appear between the before-treatment cephalogram and the second cephalogram do not give a true picture of what really happened after treatment, since the patient was out of retention when the second cephalogram was taken.

It is evident (Fig. 9) that most of the increase in face height and anterior movement occurred between the ages of 13 and 15 years, after treatment had been completed. The cephalogram shows that the upper molar was depressed vertically 10 mm. and the lower molar moved upward 8.5 mm., demonstrating that there was very little extrusion of the upper molar in relation to growth. Anterior face height grew 16 mm. and further increased 7 mm. after retention; posterior face height increased slightly more, to 16.1 mm., and increased an additional 6.5 mm. after retention.

The Frankfort-mandibular angle decreased from 26.5 to 24 degrees and to 23 degrees out of retention. According to posttreatment measurements, the upper first molars grew 4 mm. downward and the upper first molars grew 1.1 mm. upward. There was an 8 mm. anterior horizontal movement of the upper molars after treatment and 5 mm. more in the postretention period. The lower molar moved anteriorly 13.5 mm. after treatment and 4.5 mm. out of retention, while point A moved forward 5.4 mm. after treatment and then moved another 6.5 mm. out of retention. Similarly, point B was displaced anteriorly 8 mm. and 6 mm. more out of retention.

This case was treated on a nonextraction basis. It would have been harder to treat it in this manner without the early use of cervical traction. No Class II elastics were used. Good results were obtained in correction of the Class II relationship, particularly in the deep overbite, with good arch form and facial esthetics.
Treatment of Class III cases

Class III cases in the mixed dentition can be diagnosed as pseudo or true Class III malocclusions, but in the early ages it is sometimes difficult to differentiate between the two. The heredity of the patient should be carefully evaluated before one decides on the initiation of treatment. A monobloc can be tried, as advocated by Woodside,21, 22 in selected cases. Rapid palatal expansion can also be attempted in some cases.3 However, the orthodontist must be very vigilant of growth. In many instances, I prefer to wait, since the case could easily develop into one requiring surgical intervention.

The orthodontist has many roles. He is a teacher who must instruct his patients in the proper care of their mouths and prepare them for orthodontic treatment. He is a friend who must understand his patients’ problems and boost their morale. He is a psychologist who must comprehend his patients and find the best approach for each one. He must play all of these roles if he is to achieve proper cooperation, which is so essential for the changing of maxillofacial cripples, who could have had extensive emotional upheavals, into normal persons with healthy mouths and esthetic faces.

Summary and Conclusions

This article has stressed the importance of proper diagnosis, the starting of treatment at an early age, the use of simple mechanics, and the evaluation of
Fig. 9—Cont’d. For legend, see opposite page.
growth during treatment. The method of evaluating growth by means of linear measurements facilitates the verification of changes and has the added advantage of showing more clearly what really occurs several years out of retention. It is evident that the magnitude of posttreatment changes is as great as, or greater than, changes occurring during treatment. This point, which is seldom taken into account in treatment planning, is of the utmost importance in understanding the long-term stability of cases. In conclusion, it must be stated that orthodontic treatment can be greatly simplified if started at an early age.

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