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PLANAS DIRECT TRACKS IN YOUNG PATIENTS WITH CLASS II MALOCCLUSION

In Brazil, Class II malocclusions affect approximately one-third of children in the primary dentition period, and approximately two-thirds of the adolescent population. According to many authors, this type of malocclusion worsens with time, due to facial growth during childhood, both in terms of quantity and quality, and the facial pattern is established at an early age. The application of the Planas Direct Tracks concept and technique may represent an interesting tool for the correction and prevention of Class II malocclusion in an early treatment approach, working 24 hours a day, 7 days a week, applying oral functions and muscle activity to correct the malocclusion. World J Orthod 2005;6:355–368.

Class II malocclusion is a relatively common alteration of the stomatognathic system in primary dentition. According to da Silva,[1] 33.68% of children in the primary dentition stage in the Bauru area of the state of São Paulo, Brazil, have a Class II malocclusion. Commonly, deep overbite, mandibular retrognathism, and Class II malocclusion at the canine level accompany Angle's designation of molar relationships. These percentages are worse in the late-mixed dentition stage, and are likely associated with a Class II evolution from Class I occlusions with a flush terminal plane, as pointed out by van der Linden et al.[2]

As stated by Baccetti et al[3] in 1997, "...the results of this study indicate that the clinical signs of Class II malocclusion are evident in the deciduous dentition and persist into the mixed dentition." The interval considered during the Baccetti et al study averaged 2 years 6 months ± 9 months in duration, shows a progressive worsening of the malocclusion, with the involvement of the maxilla, which may become prognathic in some individuals.

Another important consideration is the amount of facial and mandibular growth that occurs during childhood (Table 1). According to Nanda,[4] "The pattern of development in each facial form is established at a very early age, even before the eruption of the first permanent molars and long before the adolescent growth spurt." This may explain why the clinician does not see facial pattern changes during adolescence.

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Table 1 Linear growth measurements (mm) from 1 to 18 years of age

Age	Cranial base (N-S)	Maxilla (ANS-PNS)	Mandible (Ar-Gn)
1	55.0	38.8	71.0
3	61.1	43.2	81.5
6	64.7	47.0	90.0
9	67.2	50.2	97.0
12	69.6	53.0	103.0
18	72.8	56.8	115.0

Data from Broadbent[7] (Gribel[6]).

Snodell et al[5] showed in 1993 that "At 6 years of age, the transverse dimensions had a greater percentage of the adult size completed than the vertical measurements for both males and females. All the transverse measurements were over 80% complete in growth by age 6 years when using age 18 years as 100%, with the exception of nasal width for males, which was only 75% complete." Gribel[6] applied the same methodology to 3 different longitudinal series (Broadbent,[7] Bathia and Leighton,[8] and Martins et al[9]), and reported that not only 80% of transversal growth is present in a child 6 years of age, but also 80% in the longitudinal aspect, including the cranial base, maxilla, and mandible (Table 1).

It is interesting to see from values in Table 1 (data from Broadbent[7]) that, at 1 year of age, there is more than half (68.3%) of the adult horizontal component of the maxilla (ANS-PNS) and 61.7% of the adult mandibular diagonal length (Ar-Gn).

The effects of mandibular change of posture are well established in the literature. In the 1970s, the Petrovic et al[10,11] servo-system facial growth theory started a new era in terms of methodology. More recently, Fuentes et al[12,13] have shown that after advancing the mandible with a functional appliance, not only are there increases in the condylar cartilage thickness as well as in the number of dividing cells at the mitotic compartment, there are also important effects on gene expression in the condylar cartilage, following the lateral functional shift of the mandible. Voudouris et al[14–16] and DeGroote[17] demonstrated that just as the growth of the mandible is affected, other areas are also influenced by the change of the mandibular posture. New bone formation at the head of the condyle and mandibular fossa of temporal bone has been observed. When restriction of maxillary growth is added, overall dentofacial orthopedic contribution is approximately 70% and orthodontic (dental) contribution is approximately 30%. Voudouris[14] concluded, "The potential for condylar growth in juvenile nonhuman primates in the mixed dentition to induce increased mandibular length appears to be great."

Figures 1 to 6 show an interesting demonstration of these experimental facts in humans. At 6 years of age, a girl had a bicycle accident and fractured the right condylar head of the mandible. Nearly 3 years later, the oral surgeon recommended an orthopedic evaluation, because the mandible started showing a lateral shift and there was facial asymmetry, which can be seen in the panoramic and lateral radiographs (see Figs 1 and 2). At this point, the head of the mandible showed the "bifid head of the mandible" (bifid condyle) aspect. After 2 years 9 months of treatment, with a series of functional appliances, starting with a Bimler A1, substituted 6 months later with a Simões Network 1, and finally Indirect Simple Planas Tracks with laterally inclined tracks, interesting adaptations were observable, both in the condyle of the mandible and the mandibular fossae of the temporal bone (the cranial base). The posttreatment radiograph (see Fig 3) shows only 1 contour of bilateral structures (orbits, key ridge, great wings of sphenoid, and mandibular borders), suggesting a correction of the asymmetry. Observe that not only 2 mandibular heads are present at the right temporomandibular joint (TMJ) (see Figs 4 to 6), but there are also 2 mandibular fossae (1 medial, the other lateral). Both fossae are at a lower height, compared with the left TMJ. This indicates that the top of the mandibular fossa of temporal bone had remodeled downward, toward the 2 heads of the mandible.[14–16] It seems that these modifications at the TMJ level occur not only in nonhuman primates, as Ruf and Pancherz have shown with TMJ MRIs.[18]

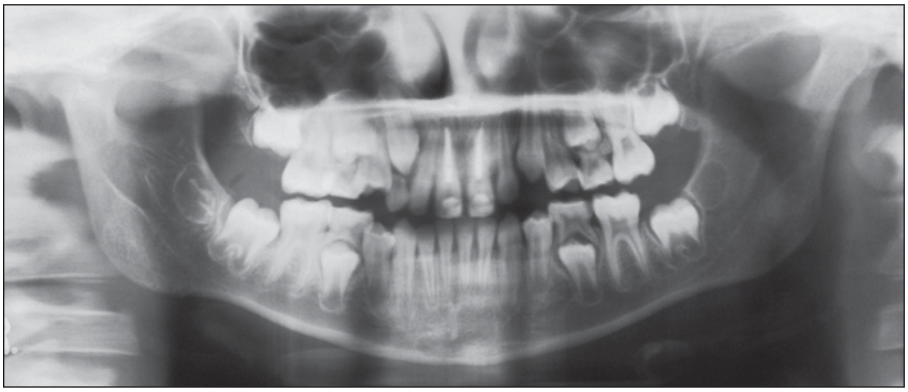
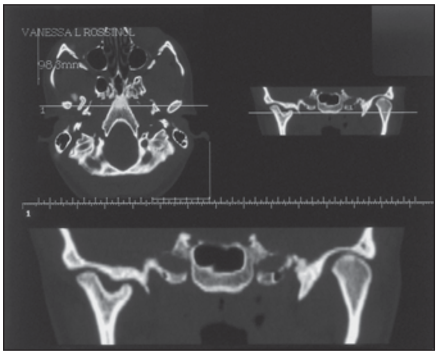


Fig 1 *(above)* Pretreatment panoramic radiograph.

Fig 2 *(right)* Pretreatment lateral radiograph showing 2 mandibular borders.

Fig 3 *(left)* Lateral radiograph showing bilateral structures superimposed, without double contours, even at mandibular lower and posterior borders, demonstrating the correction of mandibular asymmetry, 5 years after functional appliance removal, without any retainer.

Fig 4 *(right)* Three-dimensional reconstruction, showing bifid right condyle, 6 years after treatment.



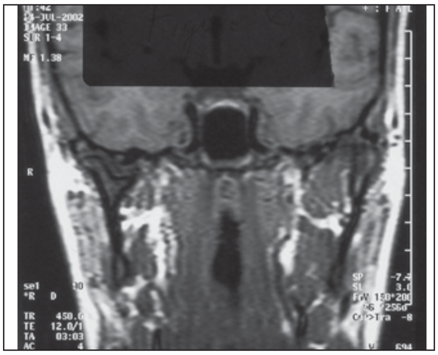


Fig 5 *(left)* Computerized tomograph, coronal view, showing 2 fossae and 2 heads of the condyle in the right TMJ, both below left TMJ level, demonstrating remodeling at the right fossa level, after treatment with a series of functional appliances.

Fig 6 *(right)* Magnetic resonance image, coronal view, 7 years after treatment, corroborates findings shown in Fig 5.

Figures 1 to 6 are from a previously published case report that demonstrated TMJ plasticity.[19] The initial mandibular shift and facial asymmetry were corrected by means of modeling new bone and remodeling old structures.

During childhood there is a great intensity and velocity of facial growth,[5,6] and if it is possible to moderate the amount of growth of the mandible and mandibular fossa of the temporal bone,[10,11,14–19] then it may be possible to interfere in, treat, and correct Class II malocclusions during the primary dentition period, in time to affect the facial pattern.[4]

PLANAS DIRECT TRACKS TECHNIQUE

The Planas Direct Tracks (PDT) technique represents an interesting early treatment approach to correct and prevent Class II malocclusion. Patient compliance is a treatment concern when using functional orthopedics with removable appliances, even though young patients are easier to influence and to obtain cooperation from than adolescents.[20] This concern applies with any kind of removable gear, such as elastics, headgear, facial mask, etc. Since PDT are “glued” to the teeth, they work 24 hours a day, 7 days a week. According to Voudouris et al,[16] “Fixed functional appliances produce consistent and reproducible head of the mandible-fossa changes compared with the inconsistent results reported in the literature for removable functional appliances.” Further investigation may corroborate these findings with PDT therapy. It has been postulated that these fixed functional appliances are more efficient because they maintain the change of the mandibular posture at all times, including during mastication. Planas,[21] Simões,[22] and Hylander[23] have demonstrated the important role of mastication in modeling and remodeling of the stomatognathic system. Occasionally, in some patients, during some periods of the treatment, it is necessary to complement PDT action with an appliance or myotherapy to improve tongue, lip, cheek, and facial muscle activity.

Diagnosis is an essential step in any kind of treatment. Cephalometric analyses are often not available for this stage of development. Facial proportions and maxillomandibular relationships are therefore obtained by facial analysis. Dental casts and direct examination of the patient may provide good information in terms of careful planning. Planas symptomatologic gnathostatic and calcographic diagnosis is effective in determining mandibular deviation, asymmetries, and underdeveloped dental arches even in young children.[21,22] A functional evaluation of the patient’s stomatognathic system, general health (respiratory alterations, postural changes) may help to identify the need for adequate stimuli. Proper respiration, mastication, swallowing, head and neck posture, and good oral habits may also affect the decision-making process and the selection of the PDT procedure.

Pedro Planas[21] developed his technique of direct tracks in the early 1970s. At that time, the tracks were made of Adaptic. Today, photoactivated (light-cured) composite resins may be easily attached to the primary dentition. There is no specific indication for a particular composite resin brand, but it must have some resistance to allow for occlusal forces during swallowing and mastication.

Placement of PDT involves prophylaxis of the enamel surfaces, followed by etching of the occlusal surfaces. The adhesive is applied to the conditioned surfaces and then light cured. Small amounts of resin are then applied over the selected teeth, building an inclined plane to advance the mandible during closure of the mouth, swallowing, mastication, and speech. It is important to build individualized tracks over each tooth, to allow normal periodontal physiology and stimulation. The Class II direct tracks show, at the beginning, a flat shape over the occlusal surface of the posterior maxillary primary molar, parallel to the occlusal plane. This allows an initial increase of posterior vertical dimension, unlocking the occlusion and, therefore, providing the mandible with more space to start moving laterally and anteroposteriorly. After a short period, approximately 1 month, more resin is added to the occlusal surfaces of the posterior teeth, and a triangular profile and a prism shape is obtained (Fig 7). The criteria to identify which teeth will be selected to receive the tracks depends upon diagnosis and treatment planning, and includes vertical dimension, tooth eruption, developmental stage of the occlusion and eruption, and adequate stimulation needs. In some mixed-dentition patients, it is possible to apply PDT to the second primary molars. In this situation, first molar eruption will provide an increase in posterior vertical dimension, both at the occlusal plane and the mandibular ramus, depending on the facial type (see case 2).

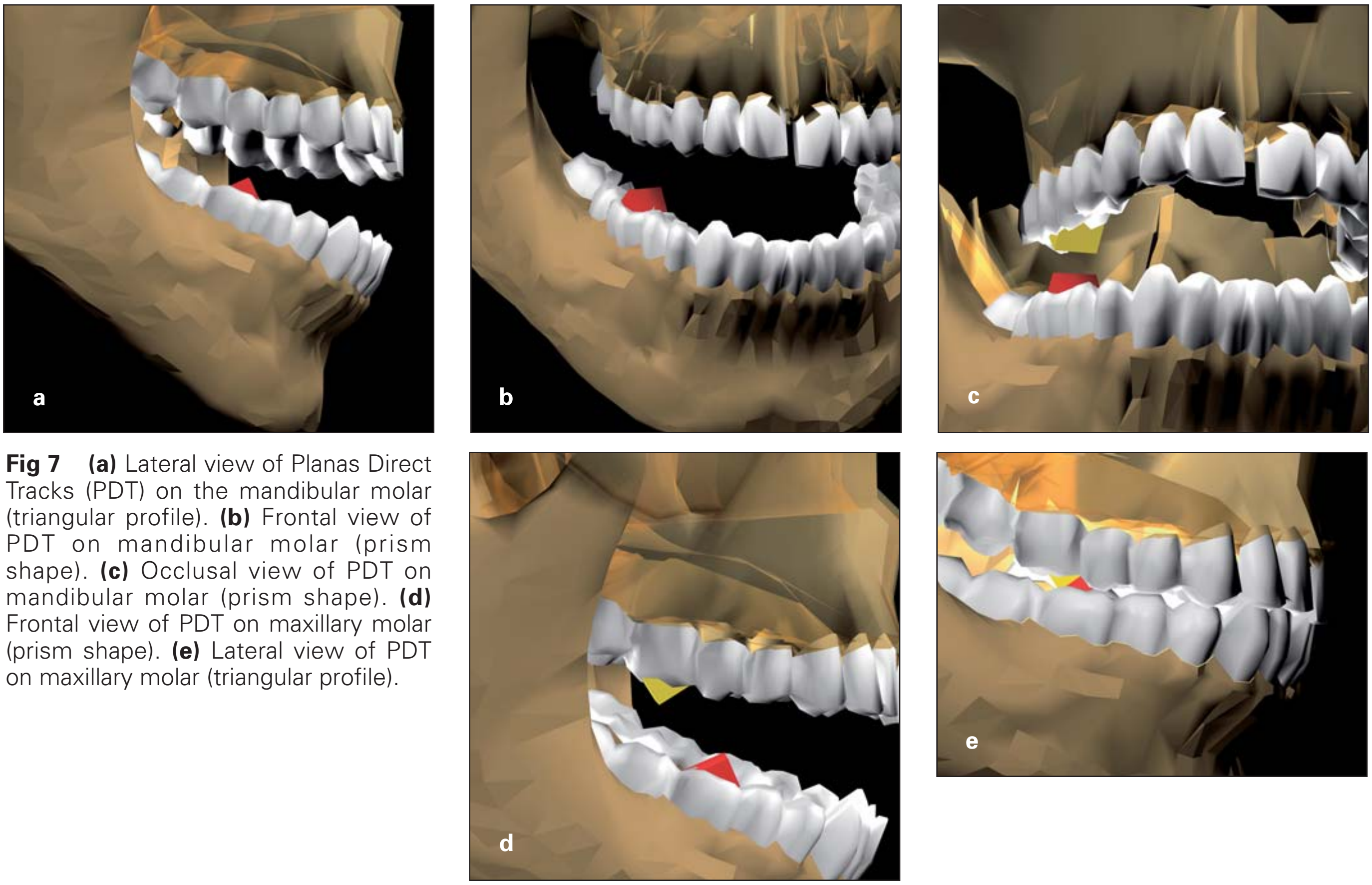


Fig 7 **(a)** Lateral view of Planas Direct Tracks (PDT) on the mandibular molar (triangular profile). **(b)** Frontal view of PDT on mandibular molar (prism shape). **(c)** Occlusal view of PDT on mandibular molar (prism shape). **(d)** Frontal view of PDT on maxillary molar (prism shape). **(e)** Lateral view of PDT on maxillary molar (triangular profile).

CASE 1

LAG was a girl, 4 years 11 months of age, with a Class II malocclusion, retrognathic mandible, and deep bite. These findings are discernable both in radiographs and photographs (Fig 8). Almost all patients with Class II malocclusions at this age also have retrognathic mandibles. Figure 9 shows the inclined planes of PDT. This is a modification of Planas' original procedure.[21] The tracks can be made directly over patient's teeth or in an indirect way, as described by Brandão.[24] The main objective is to change the mandibular posture. The tracks act as interferences in the normal closing path. The Ruffini-like mechanoreceptors—originated from the primary neurons of the mesencephalic trigeminal nucleus—detect the new occlusal contacts and command the trigeminal motor neurons to fire and activate the main protrusive muscle of the mandible, the inferior head of the lateral pterygoid muscles. Unless there is rigid fixation of the mandible, the inferior head of the lateral pterygoid muscles have to work harder to keep and sustain the mandible in a more forward position. When teeth contact, muscle spindles also will be stimulated. Whenever the mandible moves, TMJ receptors types I and II, originated from the primary neurons of the trigeminal mesencephalic nucleus (as are muscle spindles and Ruffini-like mechanoreceptors of the periodontal ligament) are stimulated. All these stimuli are consequences of the mandibular change of posture, and affect the neuromuscular response of muscles innervated by trigeminal, facial, glossopharyngeal, vagus, hypoglossal, accessory, and cervical nerves (C1, C2, C3, and C4); this effect normally happens during swallowing and mastication. All these movements result in incremental blood flow increase at the TMJ. Growth factors arrive at the condylar cartilage and probably exert influence in the number of mitotic cells and thickness of the condylar cartilage, as has been observed in adult animals.[25] The movement at the

Fig 8 Case 1. Retrognathic mandible, Class II molar and canine relationships, deep bite, "gummy" smile.

Fig 9 Occlusal views of PDT, placed on primary first molars (maxillary and mandibular).

TMJ may produce a "pump-like effect".[10,13,14–17] This theoretical model is in accordance with the Petrovic et al[10] servo-system theory and the modus operandi of functional appliances described by Simoes, Petrovic, and Stutzmann in 1992.[26]

The hypothesis of lateral pterygoid muscle inferior head hyperactivity is probably valid only for those procedures that stimulate mandibular advancement in an active way (such as Planas Direct and Indirect Tracks, Simões Network 1, MARA, twin block), rather than for those that keep and sustain the mandible in a forward position in a passive manner, such as achieved with rigid activators (ie, Bionator, Harvold-Woodside, Fränkel, Bimler, Herbst and its variations). This may explain why some authors have encountered a decrease in pterygoid activity when using activator-like functional appliances instead of an increase in its activity.

After Class II PDT are applied to the primary first molars, one normally will see a lateral open bite in Class II deep bite patients in the primary dentition (see Fig 9). This will be corrected within a few months by facial growth and tooth eruption. The continuous tooth eruption in primates and the 5 stages of eruption are well explained in the literature by many authors.[27] Tooth eruption is a natural phenomenon that should be taken into consideration during treatment planning. The clinician does not have to pull or push teeth to make things happen; most of the time, the clinician must only permit or stimulate things to occur. As proposed by Planas, in his Laws of Development, the stimulation of 1 tooth produces the eruption of the teeth that belong to the same group: there are 2 groups in the mandible (each hemi-arch) and 3 groups in the maxilla (1 anterior group, the maxillary incisors; and 2 posterior groups, including the canines, premolars, and molars from each side). This is probably related to the different embryologic origins of these components.

After 6 months, the mandibular retrognathism and the lateral open bite have resolved, due to teeth eruption (Fig 10). The Class II malocclusion and anterior deep bite also have been corrected. The Class II PDT were kept in place for an additional 2 months to ensure the stabilization of all aspects involved (functional, neuromuscular, articular, skeletal, dentoalveolar, etc). After that, they were progressively removed by gently grinding the resin. This procedure will allow primary first molars to erupt to the occlusal plane level. Figure 10 shows normalization of occlusion and of facial proportions, both in soft and hard tissues, after 6 months. The 9-month follow-up views suggest normal development of the occlusion, including a reduction of the "gummy" smile (Fig 11).

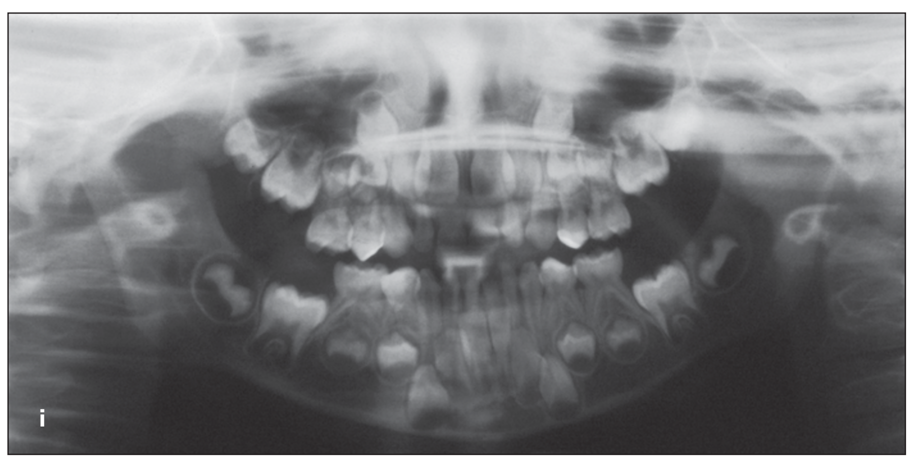


Fig 10 Case 1. After 6 months, the malocclusion is corrected, allowing normal development of the stomatognathic system. Lip exercises are often required to stimulate proper lip posture and to discourage mouth breathing.

Fig 11 Case 1. Views at 9 months posttreatment, showing normal development of the occlusion. Lip exercises may still be necessary.

CASE 2

This girl, JKA, 6 years of age, had a malocclusion similar to that of case 1, with a Class II malocclusion, deep bite, retrognathic mandible, and some "gummy" smile (Fig 12). However, her first molars were already erupting. In such a case, the primary second molar is selected to receive Class II PDT. Seven months later, the malocclusion was corrected in all 3 planes. Note that in the initial views, the patient showed an inverted curve of Spee in the maxilla. In cases like this, it is wise to supplement the Class II PDT action with a functional appliance for night-time use and, if possible, a few hours each day. If children are undergoing language training, use of the appliance during the school day is not recommended. An Equiplan, developed also by Pedro Planas, may stimulate posterior teeth to erupt, and control the eruption of maxillary and/or mandibular incisors, depending upon the placement of this stainless steel plate. The Equiplan may help to control and reduce a "gummy" smile during this stage of development. Figure 13 shows the evolution of the treatment (total active treatment time, 7 months). For the following 7 months, the appliance was used only at night, as a retainer; during this time, the Class II PDT were ground to allow the primary second molars to erupt. Figure 14 shows the normal development of the occlusion 24 months posttreatment.

Periodic follow-up visits will proceed throughout adolescence and young adulthood. This periodic observation, 2 to 4 times a year, assures the possibility of intervention if anything deviates from "normal" development, including detection or control of any sort of deleterious habits, altered functions, or disturbances in tooth eruption. In addition, this is a powerful public relations tool, since parents will mention the care of their child's dental and oral health.

DISCUSSION

With very early treatment, a second phase of treatment may not be necessary.[28] There is a good chance for normal development, if normal form and function are obtained early. The same approach is valid for any kind of preventive procedure: the inoculation of a vaccine does not mean 100% protection; periodic visits to a dentist cannot guarantee that a patient will not develop caries. However, if a patient, parents, and clinician adopt prevention in a serious manner, by watching over nutrition, breathing, etc, not only the occlusion, but the face and general health may be improved, thus avoiding or minimizing later interventions.

We can treat malocclusions at almost any age at the beginning of the third millennium. The same is true for caries: we can prevent caries with educational attitudes and supervision; remove carious lesions when superficial (enamel involved); remove them with some anesthesia (dentin involved); do endodontic treatment if the pulp is involved; or extract the tooth. In any case, the disease is treated and the patient is cured. Are malocclusions the only health problem that one should observe getting worse and then interfere?

Even the best orthodontists in the world have altered their approach during the course of their careers. Charles Tweed, often called the world's greatest orthodontist, produced outstanding results with full-banded appliances in the permanent dentition. But toward the end of his career, he stressed that mixed-dentition therapy was vital, and he accepted only mixed-dentition cases in his practice. Tweed wrote, "As we learn more about growth and its potentials, more about influences of function on the developing denture, and more about normal mesiodistal position of the denture in its relation to basal jawbones and head structures, we will acquire a better understanding of when and how to intervene in the guidance of growth processes so that Nature may better approximate her growth plan for the individual patient. In other words, knowledge will gradually replace harsh mechanics, and in the not-too-distant future the vast majority of orthodontic treatment will be carried out during the mixed dentition period of growth and development and prior to the difficult age of adolescence."[29]

Fig 12 Case 2. Pretreatment views showing retrognathic mandible, Class II molar and canine relationships, deep bite, and inverted curve of Spee in the maxilla.

Fig 13 Case 2. After 7 months, the malocclusion is corrected, allowing normal development of the stomatognathic system. Note eruption of first permanent molars and leveling of the occlusal plane.

Fig 14 Case 2. Note eruption of second primary molars, 6 months after PDT removal.

We surely know much more today[30] than 40 years ago. Why don't we take a step further?

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