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ORTHODONTIC-ORTHOPEDIC and OTOLYRNGOLOGICAL treatment of "facial insufficiency" and hyperdivergence

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''The moral perspective doesn't introduce itself with the single word ''must'' it presents itself with the verb ''to do'' with the qualification that it is 'definitive and well thought out.''
Vincent DESCOMBES
The bear's reasoning and other practical philosophical essays

ABSTRACT

In treating children who have a significant lack of space both for the correct placement of their teeth, in what is called an arch length discrepancy, as well as for proper accommodation of their airways resulting in the Obstructive Sleep Apnea Syndrome, it seems to us to be indispensable for specialists in dentofacial orthopedics and otolaryngology to share and combine their philosophies and treatment approaches. The three clinical cases that we are presenting in a virtually documentary cinemaphotographic fashion, dealing simultaneously with the skeletal, dental, and breathing aspects of the disorder, will, we hope, give an improved view of the landmarks and architecture of ''facial insufficiency'' and the ways in which it can be treated. Patients with ''facial insufficiency'' suffer from simultaneous impairment of the correct growth off the two maxillae. In addition, the failure of the two jaws to develop sagittally makes the problem difficult to detect. Patients with Class I bimaxillary retrusions make up the majority of patients seeking orthodontic treatment who have facial insufficiency. And it is only the oral examination the orthodontist makes about the lack of space for teeth that uncovers the accompanying problem of lack of space for the airways. It should be pointed out that not all

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patients with bimaxillary retrusions have insufficient airway space. Still orthopedic treatment of the dental problem, enlarging available space in the dental arches, also automatically increases available airway space. This procedure must await the restart of vertical posterior growth under the influence of upward pressure from the tongue against palatal supports that stimulate the mandibular condyles. It is understandable, then, that any blockage of nasal breathing, from, for example the inferior turbinates or enlarged adenoidal tissue or impediment to vertical tongue thrusts, from excess tonsilar tissue or tight lingual frenums would be a primary hindrance to the desired growth process. So the first orthodontic objective is freeing the tongue, the second is adjusting occlusion. Ramus growth, in fact, unlocks a verticotransverse ''raising'' action of the lower lateral sectors needed for occlusal recovery and advancement of the maxilla. The ''mandibular lock'' blocking maxillary advancement is thus opened vertically.

KEYWORDS

Facial insufficiency

Facial hyperdivergence

Verticalizing the tongue

Growth of the rami

Bimaxillary advancement

Changing dentition

Arch length discrepancy-Obstructive Sleep Apnea Syndrome-Otolaryngology-ENT.

Illustration on this page:
Willy Aracting (1930-2003), The Bear and the Man who loved gardens- oil on canvas 81 x 100 cm.

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1 – INTRODUCTION

I have prepared this article with the goal of encouraging cooperation between the specialties of orthodontics and of otolaryngology, a key point in this *varium* issue one of whose chief concepts is hyperdivergence. Let us emphasize from the very start that the clinical results I have achieved were made possible by a fruitful collaboration with an otolaryngology colleague (cf. article in the Revue d'ODF n^0 3-2010) who at all times displayed an admirable understanding of the reasons behind my referral of patients to him. We are absolutely convinced that certain results would have been

impossible without his collaboration from the inception of treatment.

But in a general way we must ask ourselves by what standards do ENT colleagues evaluate the patients we send them? Sometimes they decide to institute treatment, sometimes they elect to abstain from intervening; but the question is, how do they make the determination, in accordance with what details, what assessments, and what reasoning? Do we orthodontists have a role to play in affecting how otolaryngologists receive our requests? We firmly believe the answer is yes. And we have written this presentation with the aim of making that conviction explicit by a quasi-clinical observation of the development of the ongoing orthopedic procedure and of its effect on the upper air and digestive pathways. Demonstrating what an authentic dentofacial orthopedic and orthodontic therapeutic reduction of facial insufficiency, a veritable ''medically assisted growth process,'' can contribute to enlarging the space and volume of the airways, and especially of the naso and oropharyngeal sector, seems to us the best way of improving cooperation between the two specialties of orthodontics and otolaryngology.

2 – WHAT DENTOFACIAL ORTHOPEDICS CAN DO FOR THE AIRWAYS

A study of the patients whose cases we show here, all three of whom had narrow pharyngeal passageways, to increasing degrees of severity because of ''Facial Insufficiency,'' clearly shows what success the deployment of a continuous orthopedic procedure can have in improving airways, especially in the nasal and oro-pharyngeal regions: dentofacial orthopedics can achieve much more in this regard than is still routinely anticipated in some quarters and, in some cases, can even do it with ENT participation.

''Facial Insufficiency'' can be responsible for a dramatic lack of space for the dentition, for the tongue, and for the airways. This insufficiency, we are persuaded, can also contribute to development of the Obstructive Sleep Apnea Syndrome in ways that are still too often not understood or are misunderstood. This is complicated by some patients having severe ''facial insufficiency'' even though their dentitions are in Class I occlusion.

And sometimes when an obstacle appears in a patient's airways it becomes ''indispensable for the orthodontist to find out what the otolaryngologist can do'' by referring the patient for an assessment. The benefits of this contribution for the success of the orthopedic procedure seem to us the necessary condition for a pertinent, efficient, and, ultimately, essential collaboration.

A study of each of the three cases we are presenting, of the development of the nasal and oropharyngeal airways during the orthopedic treatment of skeletal problems derived

from mal-functioning should make it crystal clear to members of both orthodontic and ENT specialty groups ''how dentofacial orthopedics can enlarge the space available for upper airways thus improving nasal ventilation enough to cure Obstructive Sleep Apnea Syndrome or prevent its development.''

3 – HOW DENTOFACIAL ORTHOPEDICS CAN CHANGE THE DENTITION

The shared understanding that orthodontists and otolaryngologists have of ''what orthodontics can do for the airways'' derives, we believe, from knowledge of what ''orthodontics can do to prevent or cure the arch length discrepancy'' problem. Here again, in each of the three cases we present, we can see how the continuous orthopedic procedure can promote proper lingual and ramal and later occlusal and cortical bone growth by stimulating skeletal development during the mixed dentition period (LROC-CD)[1-3], an action that accelerates changing of the dentition, from about the age of three, and reduces dental crowding thanks to creation of available space. And when the arch length discrepancy is extreme because the ''facial insufficiency'' is extreme, it is sometimes the dramatic narrowness of the airways that reinforces our decision to treat a malocclusion without extracting permanent teeth. Not because of a belief in refusing orthodontic extractions at all costs but because of our belief in improving the airways at all costs. And we do this with the aid of an otolaryngologist whenever indicated. A knowledgeable otolaryngologist makes it possible for us to respond favorably to the patients and parents who consult us even though they are totally unaware that facial insufficiency is usually the cause of both arch length discrepancy and narrow airways. This is yet another reason for all of us, no matter what our therapeutic specialty may be, to have a good understanding of this overarching entity, facial insufficiency, and its responsibility for the lack of space for the dentition, for the tongue, and for the upper airways.

4 – A JOINT RE-EVALUATION OF OUR PRACTICES

We make a solemn vow that in the observation of these three cases and in understanding how effective their treatment was in reducing dental crowding, ortho-dontist will be prepared to answer traditional questions like ''In this case, to reduce crowding will it be necessary to extract teeth?'' Or, ''Would that action have impaired the orthopedic improvement of

tongue action, ramal growth, and occlusal and bone development during changing of the dentition? And, ''will this ultimately cause a reduction in space available for the upper air and digestive passageways?''[1-4]

In the same way, otolaryngologists might ask themselves, ''In this type of situation (patient 2 or patient 3) should I keep in place a ventilation obstacle to the tongue's assuming a vertical position, which is the first step in the orthopedic procedure, coming before the vertical-transverse, followed by the sagittal stages of the bimaxillary advancement? Without its removal, would making sufficient space for the digestive and upper air pathways, for the tongue, and for the dentition have been possible?''

5 – RECOGNIZING "FACIAL INSUFFICIENCY"

The cooperative enterprises of orthodontists and otolaryngologists must, of necessity, have a common understanding and conviction of ''what dentofacial orthopedics can do for the digestive and air passageways,'' that, themselves, are dependent on nasal ventilation. This also means, accordingly, what orthodontics can do for future candidates for nasal disorders or obstructive sleep apnea syndrome caused by ''facial insufficiency'' that has not been cured or even discerned. And, similarly, collaboration with otolaryngologists can help orthodontists to treat patients with malocclusions characterized by arch length discrepancies without forcing incisors into excessive labial inclination even though they have not extracted teeth. So the dilemma of moving incisors labially in an effort to avoid therapeutic extractions, or ordering the extractions in order to avoid moving incisors too far labially can at last be solved, by treatment of ''facial insufficiency.'' The repositioning of lower incisors becomes possible without extractions: the repositioning of the lower buccal segments or ''vertical-transverse elevation'' (cf fig. 1) furnishing space needed for that re-alignment...without extractions. A third way is, accordingly truly opened in orthodontic therapeutics thanks to treatment of ''facial insufficiency.'' In sum, in orthodontics as well as in otolaryngology, the detection of, the understanding of, and the treatment of ''facial insufficiency,'' a malady poorly reported but nevertheless a major component of the malocclusions of the majority of our patients, should, in our opinion, be high on the public health priority list. It seems to us that it is imperative for orthodontists to recognize and understand the contribution of *insufficient* posterior vertical dimension to malocclusions. And this concept needs to be combined with recognition of our theme of hyperdivergence, which has elements of

''facial insufficiency'' caused by *excess* of anterior vertical dimension.

Let us, therefore, learn to recognize the three dimensions, vertical, transverse, and sagittal, in both jaws, of facial insufficiency:

5 – 1 – "Facial insufficiency" caused by lack of forward positioning or bimaxillary retrusion

We must recognize a basic truth, that most of our patients have a Class I status both skeletally and occlusally, with the mesio-palatal cusps of the upper first molars resting correctly in the central fossas of the lower first molars, with no skeletal or dental overjet or overbite. However, both maxilla and mandibles are positioned distally, a condition most frequently accompanied by what De Coster and Delaire[5, 6] have described as the maxilla being set high, in its fronto-maxillary cortical articulation. This notion of bimaxillary retrusion should be an essential component of the diagnostic acumen of both orthodontic otolaryngological specialties because incomplete advancement of the two maxillae is the basic cause of lack of space for the dentition resulting in arch length discrepancy, lack of space for the tongue, and lack of space for the pharyngeal airways, a component of the obstructive sleep apnea syndrome. And when neither skeletal nor dental overjet or overbite are present, orthodontists may fail to recognize the problem of ''facial insufficiency ''caused by bimaxillary retrusion. And, accordingly, the otolaryngological problem of narrow upper airways is inadequately correlated with the orthodontic problem. So bimaxillary advancement becomes the therapeutic solution both for narrow pharyngeal passageways as well as arch length discrepancy.

Two of the patients we present in this paper, Case 1 and Case 2, both in a skeletal Class I status but with bimaxillary retrusions, illustrate this notion and the result of therapy for the dental complex as well as for the ventilation system.

It is, however important to note that patients with this type of Class I bimaxillary retrusion who consult us primarily because of dental crowding are particularly difficult to treat. They frequently have delays in growth affecting height and weight and uncontrollable habits of cheek sucking and tongue thrusting. So even when the dental crowding is considerable, we make every effort to treat these patients without extractions, hoping that a bimaxillary advancement procedure will correct their extremely narrow airways and thereby stimulate a resumption of normal bodily growth and development. At the same time we attempt to help these patients correct their cheek and tongue sucking habits that interfere with the tongue's assuming a proper upright posture.

But the bimaxillary advancement, of both the dentition and the basal bone,

is only stage 3 of our treatment program. In the first stage we deal with the vertical disorder, particularly of the tongue and the mandibular rami. Then, in the second phase there is a vertical-transverse raising of the lower lateral segments that makes clear the concept that the mandibular structure blocks maxillary advancement.

5 – 2 – "Facial insufficiency" caused by insufficient simultaneous bimaxillary descent (ramal insufficiency and insufficient decent of the palate)

As we have already pointed out, the majority of our patients, who, like Case I and Case 2, have skeletal and dental Class I malocclusions characterized by dental crowding and narrow airways, and anterior overbite, or, more precisely, decreased posterior vertical dimension caused by insufficient vertical growth of the mandibular rami.

Most often, the inadequately descended palatal plane of these patients remains higher than the occipital shell. The goal of our treatment for ''facial insufficiency'' is, in the first stage, to correct the inadequate facial vertical dimension by stimulating a restoration of ramal growth and encouraging descent of the palate through simultaneous lowering of the upper and lower maxillae.

We accomplish this by means of a therapy of ''tongue verticalizing.'' With appliances designed and modified to this end we encourage the tongue to thrust against the soft and hard palate, push the mandible downward and forward, and unlock the condyle thus generating condylar and ramal growth.

Retraining of the tongue to a vertical position should always be a component of effective nasal breathing. And because this requires the collaboration of an otolaryngologist from the inception of orthopedic treatment, the need for this team approach in every phase of the procedure remains, in our view, self-evident.

As the achievement of a vertical tongue posture becomes a reality, we have observed in this first ''tongue-ramal'' stage, a simultaneous descent of the mandibular and palatal planes accompanied by a spontaneous bimaxillary decent can clearly be seen in the three cases we are about to present.

This reanimation of ramal growth, essential in the treatment of hyperdivergence, because of its therapeutic consequences, has a special claim on the interests of both orthodontists and otolaryngologists:

– for the otolaryngologist, the descent of the palatal plane opens the naso-pharyngeal pathways, provoking a proportional descent

of the inferior turbinates as well as widening the gap of the posterior rhino-pharyngeal wall as seen radiologically.
– and for the orthodontist, the descent of the mandibular plane and the dental canal induces a simultaneous descent of the lower third molars that cross over the lower second molars, thus passing above and below them, a condition of their guided eruption.

5 – 3 – "Facial insufficiency" caused by insufficient simultaneous bimaxillary expansion (with insufficient expansion of the roots of the maxillary buccal teeth and excess expansion of the roots of the mandibular buccal teeth)

The first stage of tongue-ramal growth, by generating more available vertical space, will stimulate dento-alveolar development in both the maxillary and the mandibular buccal segments.

5 – 3 – 1 – "Raising" the mandibular buccal segments vertically and transversely

The lower buccal segments, and In particular the mandibular right and left first molars accomplish an eruptive movement into the vertical space liberated by the tongue-ramal growth of the first stage while at the same time their outspread roots contract in response to pressure from the verticalized tongue (fig. 1 a and b).

5 – 3 – 2 – Root expansion and eruption of the teeth in the upper buccal segments

The roots of the teeth in the maxillary buccal segments, and in particular those of the right and left first molar spread out in response to combined pressure of the verticalized tongue and the occlusion.

5 – 3 – 3 – Occlusal bite closure and increase of occlusal biting power (cf. fig. 2)

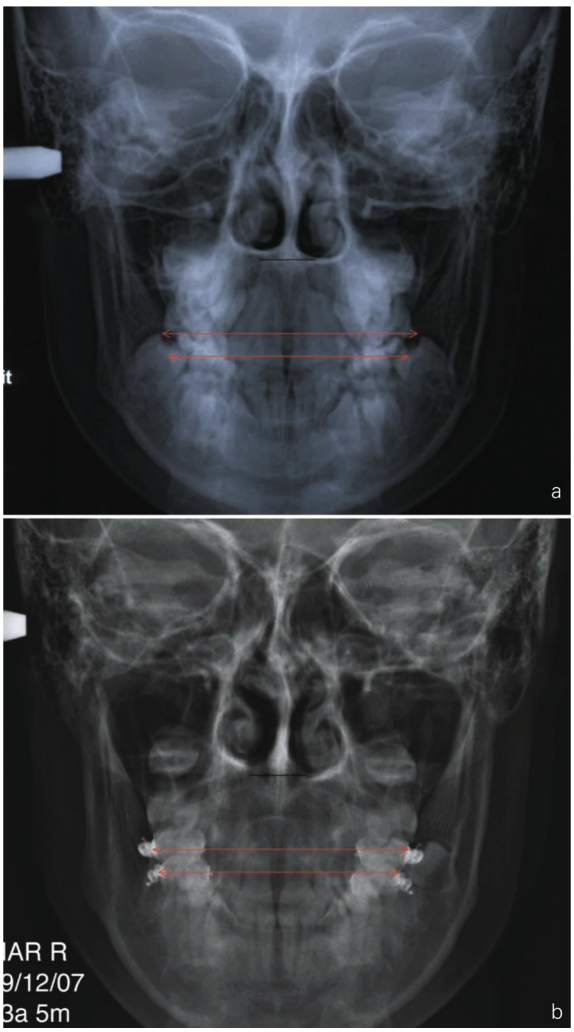
- The anterior maxillary overbite increases as the infraocclusion of the buccal segments becomes more marked, constituting what Marcel Le Gall[7] has called an inhibiting factor in mandibular masticatory movements, a view with which we agree. This restraint occurs because of a lack of guidance as the masticatory cycle begins with the centripetal movement of the mandible and by an excess of guidance at the end of the cycle. Figures 2 a and 2 b clearly show the harmony of

the guidances, reinforced at the entry into the cycles and diminished at the close of the cycles, which, accordingly, have grown larger.

- A maxillary Lip-Bumper transmits the force of the labial musculature to rotate the **upper right and left first molars** mesiobuccally. Because of this the enamel ridges, initially oriented frontally, assume a 45° orientation toward the canine on the other side of the arch which at the beginning and end of the masticatory cycle force a change in the direction of the cycles of mastication, which originally are modest and strictly oriented anteriorally. The cycles become broader and take on a 45° anteroposterior orientation, a source of maxillary centrifugal forces on entering the cycle and on the canine of the non-working side as the cycle ends. This generates:

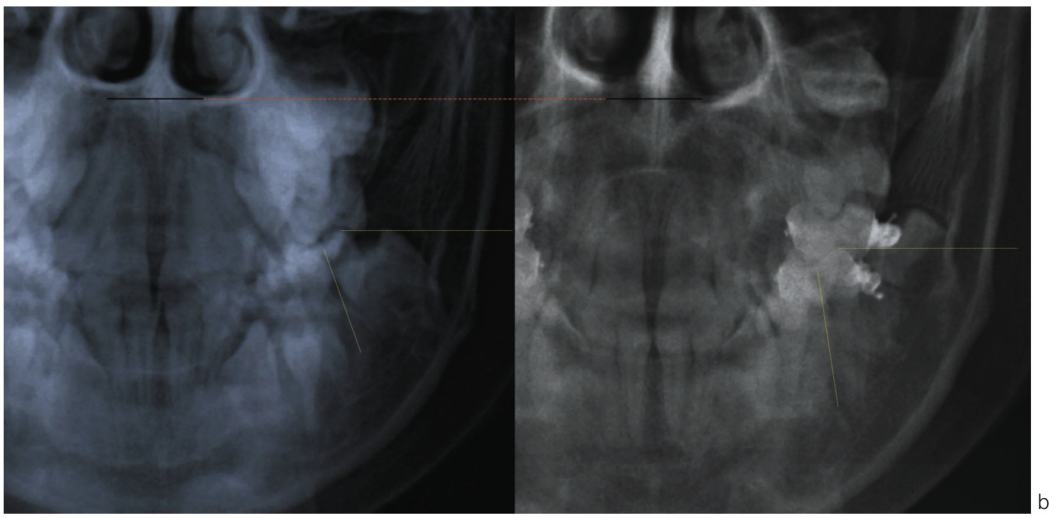
5 – 3 – 4 – Phase n^0 3 occluso-cortical horizontal of maxillary expansion and fronto-maxillary advancement with simultaneous mandibular advancement

The occluso-cortical phase of cortical adaption to the occlusion requires a previous increase in the biting force of the occlusion, which is acquired by the re-activation of tongue and ramal growth that occurs in response to unblocking of the mandible.



Figures 1 a and b

The first impression given by the juxtaposition of the two frontal films is one of global expansion. But more precise measurements made on the distance between right and left maxillary molars and right and left mandibular molars made on the final film and superimposed on the initial film show that the dental elements that moved the most were the roots and not the crowns. This resulted from a contraction or lingual movement of the mandibular roots and expansion of the maxillary roots. Note on figures 2 a and b the small yellow horizontal lines tangent to the tip of the buccal cusp of the lower molar or the lower horizontal occlusal line Ohi. Also note OHi1 and OHi2 and the overbite of the buccal cusp of the upper left first molar: on film 1 the absence of covering or infraocclusion and normal occlusion of film 2.



a b

Figures 2 a and b

During the continual orthopedic treatment that stimulates the growth of tongue, rami, and cortical bone with the change of dentition we note a profound difference in the occlusion of the buccal segments, particularly of the molars.
a: a start of treatment frontal cephalogram: the combination of the lingual crown inclination of the lower molars and the palatal inclination of the roots of the upper molars has resulted in an anterior overbite and posterior infraocclusion. In agreement with Marcel Le Galls remarks on occlusion, we think that the molar infraocclusion exerts an inhibiting locking force on centripetal mandibular masticatory movement because of insufficient dental guidance at the commencement of cycle, which can also be described as an insufficiency of the ''occlusal envelope.'' Conversely, lingually, the maxillary molar palatal cusp is too prominent and ''over-guides'' the conclusion of the masticatory cycle, with an end result of an excessively shortened cycle. In this configuration the upper first molars lack adequate mesio-buccal rotation, thus orienting their enamel ridges frontally and orienting the masticatory cycles frontally as well.
b: a frontal cephalogram taken in the midst of treatment for growth of the tongue, rami, and cortical bone. We had used only a lingual envelope of the Bonnet type and a Korn Lip-Bumper, but no rectangular wires, to apply buccal root torque to the upper first molars and to raise the lower molars in a transverse vertical direction. Following these movements there was an increase in the occlusal contacts of the buccal teeth, or a decrease in their initial infraocclusion that tended to lock mandibular movements by not providing them with sufficient guidance. The occlusal coverage or ''envelope'' established guidance at the initiation of the cycle and the over-guidance at the close of the cycle was reduced. Simultaneously the upper right and left first molars that the upper lip bumper had rotated mesio-buccally were now provided with a new 45^0 orientation of the enamel ridges oriented toward the contra-lateral canine. In sum, the masticatory cycles had regained their amplitude and their 45^0 antero-posterior component. During its centripetal masticatory movements transmits heavy forces in a centrifugal antero-posterior direction to the maxilla, which then advances frontally in a transverse sub-sinus expansion. We can, accordingly, record the following sequence:
1 – tongue and ramal growth with descent of the mandibular plane;
2 – vertical-transverse raising of the lower buccal segment
3 – buccal cortical and root expansion of the maxillary posterior teeth and frontal maxillary advancement.

6 – CLINICAL CASES OF "FACIAL INSUFFICIENCY"

CASE N^0 1 – there was no ENT consultation

This was a severe arch length discrepancy case with the blocked-out, un-erupted upper canines threatening the integrity of the roots of the upper lateral incisors. The upper airways were extremely narrow with the oro-pharyngeal passages having a filiform appearance. Class I skeletal bimaxillary retrusion with severely short mandibular rami.

CASE N^0 1 **MAD. Mar.** Initial assessment Clinical and panoramic X-ray examination (fig. 3 a to h)

Figures 3 a to h

Note the narrowness of the lower arch, clearly seen on the occlusal intraoral photograph as well as the frontal cephalogram. We felt that transvers correction was secondary to vertical correction because ''raising'' of the buccal segments required an initial vertical improvement of the tongue and the rami, then of the alveolar segments before the expansion could be undertaken. This is, in fact, our principal therapeutic thesis.

MAD. Mar. Clinical and panoramic X-ray assessment (fig. 3 i to l).

Figure 3 i

Initial profile cephalogram shows ramal vertical insufficiency and dwarfed appearance. The palate has not descended adequately, is not adequately vaulted and alveoli are low. Note lack of space for the dentition and the tongue and the airways that add up to tridimensional bimaxillary insufficiency.

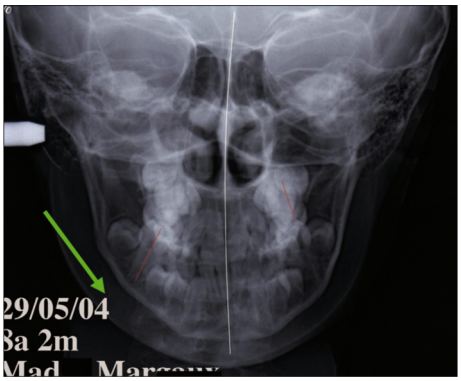


Figure 3 j

Initial frontal cephalogram shows the facial asymmetry. Because of the right condyle's apparent greater development than the left, menton has shifted toward the left. The axial inclination of the lower molars seems to be related both to lower root expansion into the space left vacant by the low-lying tongue, which has forced the anterior teeth labially, and by the crowns of the mandibular posterior teeth having tipped into that same available space. These manifestations can be corrected by establishment of vertical space for a vertical-transverse ''raising'' of the buccal segments.

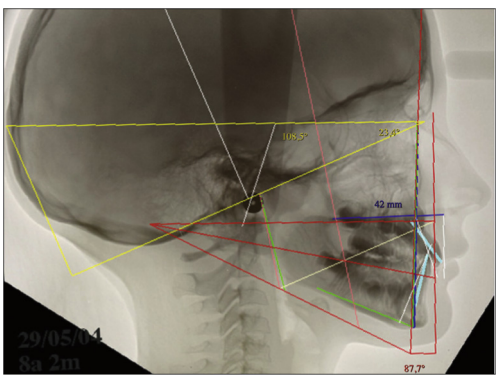


Figure 3 k

Delaire's orthognathic analysis shows that the palatal plane has not descended sufficiently, remaining at a level higher than the cranial base to which, in normality, it is tangential. This insufficiency is related to the inadequate descent of the mandibular plane caused by insufficient ramal growth and tongue development often associated with small condylar head in skeletal Class I cases.

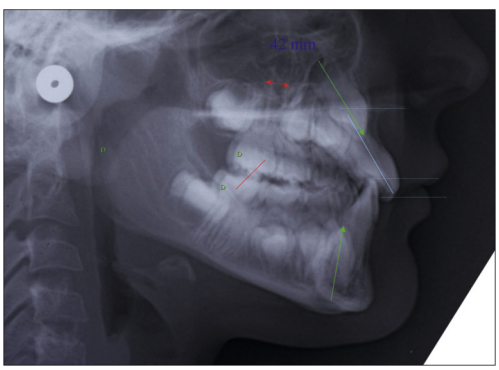


Figure 3 l

The insufficient ramal height and the misshapen condylar head can be seen (by especially sharp-eyed clinicians) in this profile cephalogram. The descent of the palatal plane, the depth of the palatal vault, and the alveolar plane itself are all insufficient. Note how the apices of the upper first molar roots project well above the palatal plane as the two small red arrows indicate. In addition, the roots of the upper central incisors abut the palatal plane and, accordingly, cannot be intruded. The roots of the lower posterior teeth also impinge upon cortical bone.

MAD. Mar

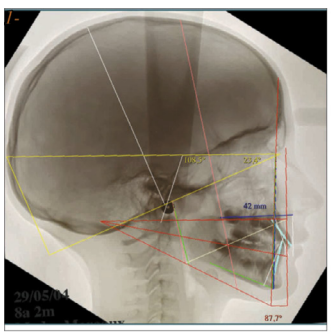
Delaire's orthognathic analysis and tongue-ramal-occluso-cortical superimpositions show the orthogonal observation lines of the bimaxillary descent and advancement. The structural observation lines of the ramal and palatal descent and the counter-clockwise occlusal and mandibular rotation can also be seen. (fig. 4 a to c).

Figure 4 a

Delaire's orthognathic analysis showed a Class I bimaxillary retrusion.

- *sagittally, an alignment of F1, FM, Np, and Me, with F1 in red, FM-Np in dark blue, and FM-Me in green. While this is a Class I skeletal case, point FM is too retruded, indicating flatness or retruded, brachymaxilla whose length is 42 mm instead of the normal 47 mm at the patient's age of 9 years, a 5 mm shortage of each hemi-arch length, or a marked shortage of available space for tooth eruption. Lower incisors, in light blue, are advanced beyond their ideal position, shown in white, putting them in a Class III tendency position.*
- *Vertically, the insufficiency derives from the distorted condylar head and the short rami. Descent of the palatal, occlusal, and mandibular planes are all insufficient. The palatal vault is too shallow and maxillary arch length is inadequate in what Bassigny has called DAD, or Dento-Alveolar-Dysharmony.*

All these factors add up to a characterization of ''facial insufficiency,'' despite the occlusion being in a Class I skeletal relationship. The lack of bimaxillary advancement is the root cause of crowding in all sectors of the dental arches as well as the narrowness of the pharyngeal opening.



Figures 4 b to e

Profile cephalograms 1, 2, 3, and 4.

(To see how we superimposed the films see Figure 16 p to r.) Note the extreme narrowness of the nasal and oro-pharyngeal airways that is related to the severe arch length discrepancy that also is responsible for the threat that the blocked-out but erupting upper canine teeth pose to the roots of the upper lateral incisors as seen in the panoramic film of Figure 5. Orthopedic therapy of encouraging tongue, ramal, and occluso-cortical growth during the dentition changing period, implemented in this case with modified Herbst rods and later with a Bonnet tongue envelope and a Korn lip-bumpers, adapted post-orthopedically to have a tempero-mandibular and dental action. Delaire's orthopedic mask, as adjusted by Salagnac, was also used to apply anterior force to the maxillary block to stimulate:

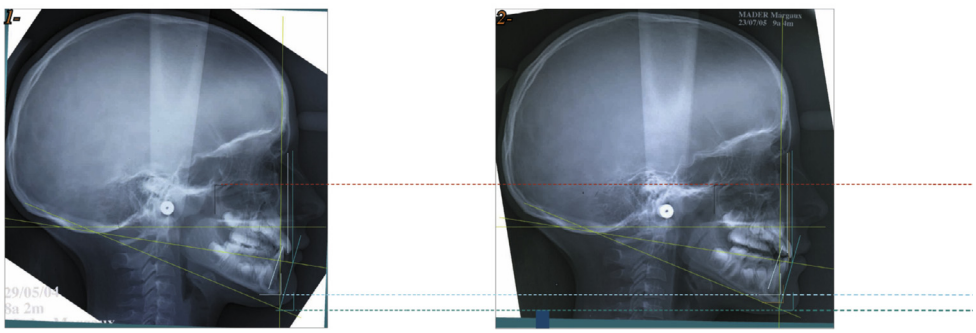


Figure 4 b

Profile cephalogram: orthodontic assessment.

Note, vertically the lack of development owing to short ramal height and deformed condylar head, insufficient descent of the palatal plane that remains above the level of cranial base, the flat palate, the projection of the apices of the upper first molar roots above the palatal plane all of which contribute to the lack of space for the dentition, the tongue, and the upper airways.

Figure 4 c

Profile cephalogram 2 taken during treatment with Herbst rods supported by splints.

Even though the occlusion is skeletal Class I and there is no overbite, the Herbst rods play a therapeutic role in stimulating vertical growth of the mandibular rami. Note the bilateral posterior open bites that have occurred as a result of ramal growth and the beginning of enlargement of the naso and oropharyngeal opening that is significant but not yet sufficient.

MAD. Mar. (fig. d to f)

1/A descent of the mandible
The first and principal response is vertical, as the tongue and rami resume development, a veritable ''homeorhesis'' for the rami. Note that ramal growth begins as the palate descends simultaneously, which accomplishes a widening of the naso-pharyngeal opening.
2/A maxillary advancement or, more precisely, an occluso-cortical advancement of the frontal sector of the maxilla.
By aligning films 1 and 4 vertically, keeping the registration-alignment on the dotted red line tangent to the posterior border of the pterygo-maxillary fissure (figures 4 f and 4 e) the sagittal occluso-cortical response of the maxilla can be seen in the advancement of the fronto-maxilla that creates space for the dentition and consequent eruption of the maxillary canines at the age of nine, the maxillary second molars at the age of twelve, and the maxillary third molars between 18 and 20 years of age. In addition, space has been made available for the tongue and the upper airways.
3/A mandibular advance
The mandibular advancement that occurs simultaneously with the fronto-maxillary advancement prevents ''compression'' of the tempero-mandibular joint against the atlas bone and also limits posterior extension of the tuberosity of the body of the mandible thus increasing available space for the tongue and, accordingly, widening the pharyngeal opening. It is also important to note that the MANDIBULAR AND OCCLUSAL PLANES ROTATE COUNTER-CLOCKWISE in conjunction with the bimaxillary advancement. This is particularly important in the treatment of hyperdivergence.

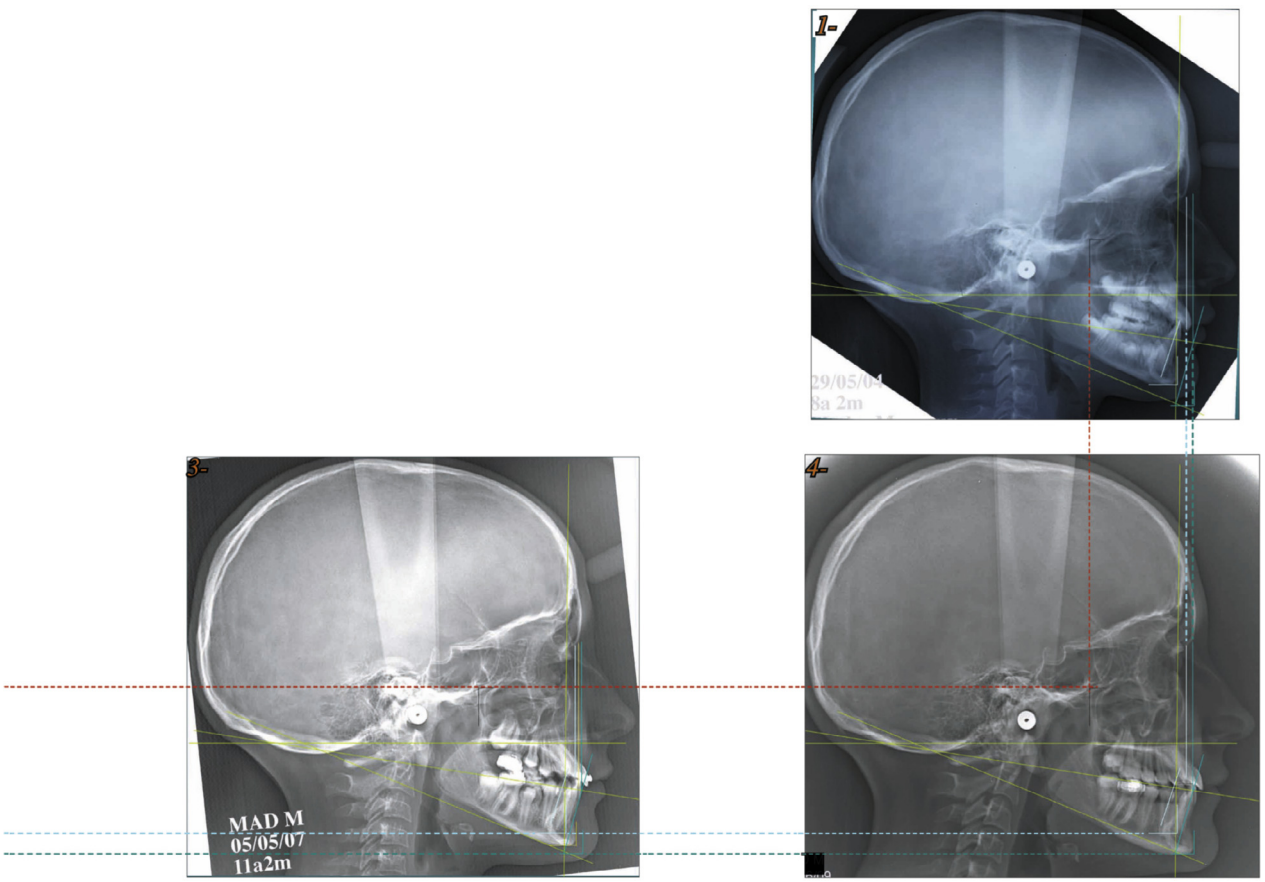


Figure 4 d
Profile cephalogram 3 showing post-orthopedic adaptation of the tempero-mandibular joint and the dental occlusion that has followed treatment with a nocturnal lingual envelope and a Delaire-Salagnac mask applied to an upper anterior sectional arch. Note the ventilation progress as the nasal and oropharyngeal openings continue to widen as the upper canines erupt into the spaces created by the fronto-maxillary advancement.

Figure 4 e
Profile cephalogram 4 after retention with a nocturnal tongue envelope. The twelve-year molars have erupted. Note continued enlargement of the upper airway apertures as well the mandibular descent and advancement and the fronto-maxillary advancement. There has also been COUNTERCLOCKWISE ROTATION OF THE MANDIBULAR AND OCCLUSAL PLANES.

MAD. Mar

Panoramic X-ray films 1 and 2 taken during orthopedic treatment with Herbst rods, rapid palatal expansion, with markings, and anterior advancement by means of a mask of Delaire applied to an anterior sectional arch wire for the final three months (fig. 5 a to b and e to g).

Figure 5 a
Panoramic X-ray 1 – orthodontic assessment.
Severe arch length discrepancy with the erupting, but blocked-out, upper canines posing a threat to the integrity of the roots of the upper lateral incisors. Using Herbst rods set in splints, rapid palatal expansion, occlusal pathways, and a lower incisal splint, followed by an orthopedic mask of Delaire-Salagnac that opened space for eruption of the blocked-out upper canine teeth. Note that the view of the palatal plane on the panoramic film demonstrates that the patient's head was well oriented when it was taken. So the mesio-version of the crowns of the posterior teeth is a correct reproduction of their actual linguo-version caused by insufficient vertical growth of the mandibular rami and the alveolar processes. The vertico-transverse ''raising'' of the lower buccal segments could have been productively augmented by the use of Herbst rods to create mandibular expansion but we mistakenly failed to realize how useful they would have been in this case.

Figure 5 b
Panoramic X-ray 2: checking eruption of upper canines during orthopedic treatment with Herbst rods.
We take check-up panoramic X-ray films every 6 to months in cases where ''spontaneous'' eruption of upper canines poses potential risks to roots of adjacent lateral incisors that we have left free to assume mesial root inclination during the process. We delay, accordingly, placement of a sectional arch to provide the anterior segment with the forward force to be generated by a Salagnac type version of the Delaire mask that we now use in conjunction with Herbst rods. That is when spaces open for eruption of maxillary canines as we carefully monitor the integrity of the maxillary lateral roots. It should be noted that when we use a lower ''expander'' in cases of vertically limited alveolar processes and lingual inclination of posterior molar teeth, we conserve transverse harmony between the two arches by increasing the palatal expansion. Our patients wear a Delaire mask only for the final three months of the Herbst rods treatment and not after it.

Figure 5 e
Dentofacial orthopedic assessment.
The forward positioning of the teeth of the lower arch and especially the roots of the anterior teeth suggest that the dentition could assume a Class III relationship. Note the absence of a substantial anterior overbite, which is also associated with a Class III tendency, which would, according to conventional orthodontic thought, contraindicate the application of a powerful Class II type of force. Nevertheless, we used Herbst rods in an effort to reduce the posterior vertical insufficiency in a first stage of therapy that would encourage simultaneous bimaxillary descent and permit, in the space created, bimaxillary expansion coordinated with ''transverse vertical raising'' of the lower buccal segments and bimaxillary advancement.

Figure 5 f
Phase of orthopedic treatment with Herbst rods.
We created space for eruption of the maxillary canines by using Herbst rods. At this stage we aligned the upper anterior teeth with a sectional arch wire but did not yet begin treatment with a Delaire mask so that the additional space was created by the effect of the Herbst rods on tongue posture and on dental occlusion, by rapid palatal expansion sometimes accompanied by mandibular expansion. Although only slightly activated in propulsion, the Herbst rods exerted a highly beneficial extra-oral type force on the maxillary buccal segments. Note the insufficient vertical maxillary alveolar height in relation to the insufficient ramal height.

Figure 5 g
Phase of orthopedic treatment with Herbst rods.
This intraoral photo was taken at the same stage as the preceding photo but here the Herbst rods have been removed. Note the amount of space opening for eruption of the maxillary canine that would have been accelerated by the use of a lower expander that would encourage vertical transverse ''raising'' of the mandibular buccal segments. An acceleration of this ''raising'' would have stimulated an earlier occluso-cortical response of maxillary expansion and advancement. Note that the raising of the anterior supraocclusion as well as the appearance of lateral open bites demonstrate that the low alveolar height and posterior infraocclusion reflect a temporary manifestation of restored ramal growth that has not yet stimulated a corresponding alveolar vertical growth.

MAD. Mar

Panoramic X-ray 3 taken during the post-orthopedic tempero-mandibular and dental occlusal adaption phase as the nocturnal lingual envelope and lip-bumper are being used. Panoramic film 4 was taken during retention period with a bonded maxillary lingual arch and continued use of mandibular nocturnal lingual envelope (fig 5 c, d and h to j).

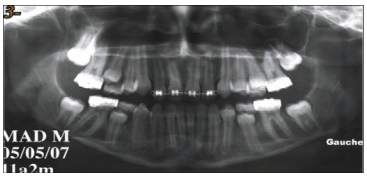


Figure 5 c

Panoramic check-up X-ray 3 in the post-orthopedic tempero-mandibular and dental occlusion adaption phase as the nocturnal lingual envelope and lip-bumper are worn.
The anterior sectional arch wire is worn only during the last three months of the Herbst rods treatment and not afterwards. Note the spaces that have opened for eruption of the upper canines as well as the vertical transverse ''raising'' of the buccal segments that has reduced the mesial inclination of the posterior tooth crowns.

Figure 5 d

Panoramic check-up film during retention period with bonded maxillary lingual arch and lower nocturnal lingual envelope and lip-bumper.
The patient's head was poorly oriented when this film was taken as palatal plane not being horizontal demonstrates. This gives the erroneous impression that the crowns of the maxillary posterior teeth are inclined mesially. Note that the apices of the maxillary posterior teeth no longer protrude past the palatal plane as they did in previous panoramic films. The upper right and left second molars are taking their places in the arch.

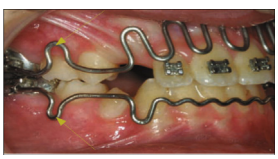


Figure 5 h

Post-orthopedic tempero-mandibular and dental occlusion adaption phase with use of Bonnet's nocturnal lingual envelope and the Korn lip-bumper after the Herbst rods are discontinued. Note that the lingual envelope, routinely employed at this time and worn at all times except school hours, becomes the principal support of correct tongue posture, which, through its vertical position and frequent thrusting against the palate, is responsible for retention in the vertical, transverse, and sagittal senses. It will not be restricted to nighttime wear only until the posterior teeth have come into firm occlusion. Also note that the inadequate vertical growth of the upper alveolar process has made it difficult to place the incisal loops of the lip bumper correctly.

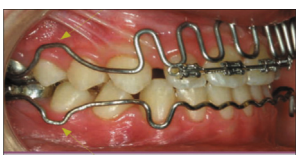


Figure 5 i

Post-orthopedic tempero-mandibular and dental occlusion adaption phase with use of Bonnet's nocturnal lingual envelope and the Korn lip-bumper.
At this more advanced stage of treatment note how we have opened the loops in the bicuspid areas of the upper and lower lip-bumpers, thus increasing arch length more than enough to make room for the erupting maxillary canines. We later detailed space closure with a full bonded and banded appliance. This space closure in a dentition that initially showed a distressing (for the worried practitioner) lack of space is a routine occurrence with our treatment protocol. But it must be noted that the shedding, or extraction, of the second temporary molars also contributes to the creation of added arch space to accommodate the erupting canine teeth.

Figure 5 j

Post retention.
At this stage the patient must continue to try to correct tongue posture because ramal growth is not yet adequate and the vertico-transvers raising of the lower buccal segments is also insufficient. In addition, the maxillary alveolar process has not yet reached the desired height. If occlusal contacting becomes more forcible, if anterior overbite reaches the desired level without locking movements in a ''wide centric'', and if the enamel ridges of the upper first molars are rotated45^0 in the direction of the contralateral canine the mandible in its masticatory cycles, now wider and provided with an antero-posterior component, will assure that an expansion and advancement of the maxilla will occur simultaneously with the mandibular advancement of puberty.

MAD. Mar

Development of the face as seen in successive cephalograms and photographs (fig. 6 a to c and 7 a to c).

Figures 6 a to c

In this series of three frontal cephalograms we can observe the ''raising'' of the lower buccal segments, a phenomenon that is at first vertical and then transverse. This vertical-transverse correction occurs in the free vertical area opened by the Herbst rods assisted tongue ramal growth. This can result from the sole influence of functional forces without the therapeutic assistance of the rods if these devices, as was the case here, do not have a lower expansion component. The incorporation of a lower expanding force into the Herbst rods is indicated whenever the initial frontal cephalometric film indicates that crowns of the mandibular posterior teeth are inclined lingually and need to be uprighted. This lower expansion would increase the extent to which the maxilla could be widened by rapid palatal expansion thus accelerating the vertical transverse raising of the mandibular buccal segments and make wearing the rods less difficult for the patient. Note also the progressive development of the frontal sinus and the occluso-cortical response to tongue ramal growth in relation to fronto-maxillary advancement.

a b c

Figures 7 a to c

In this series of three full-face photographs we can observe the simultaneous transverse development of the upper and lower jaws. Note the increased size of the upper lip and the extension of the vermillion border, the extension of the labial rim, and the raising of the commissure. The initial mandibular asymmetry has also been reduced.

MAD. Mar

Development of the facial profile as shown in successive profile and three-quarter photographs (fig. 8 a to e)

a b c

Figures 8 a to c

This series of three profile photographs shows how the upper and lower jaws have descended and advanced in harmony. Note in particular the advancement of the paranasal regions that were initially retruded; the changes in the appearance of the upper lip: the increase in volume and the extension of the vermillion border, the accentuation of the labial rim, the raising of the labial commissures; and the extension of the sub-mental region.

d e

Figures 8 d to e

These two three-quarter views show the dilatation of the face in the vertical, transverse, and sagittal senses: a simultaneous bimaxillary phenomenon. The medically assisted growth has opened space for the dentition, the tongue, and the upper airways. The tongue-ramal-occluso-cortical therapy provided during the time of the mixed dentition accelerated the change of dentition by about three years allowing treatment to be continuous, with no interruption or observation period, and to be completed before the beginning of adolescence. We have found that cooperation of pre-adolescents, during the psychological latency period, is ideal. No randomized American studies have been devoted to growth centered treatment of Class I skeletal children, who constitute 80% of our patients, in a single phase. The effectiveness of this therapy is, we believe, great enough to change the widespread skepticism about the utility of orthopedic therapy for malocclusion.

CASE N^0 2 - LEV. Max. : ENT treatment, cauterization of the inferior turbinates during the retention phase

Upper airways extremely narrow despite two otolaryngological operations. History of Obstructive Sleep Apnea Syndrome so severe that risk of morbidity from inflammatory episodes was so high during his early infancy that his parents kept him upright during sleeping hours.

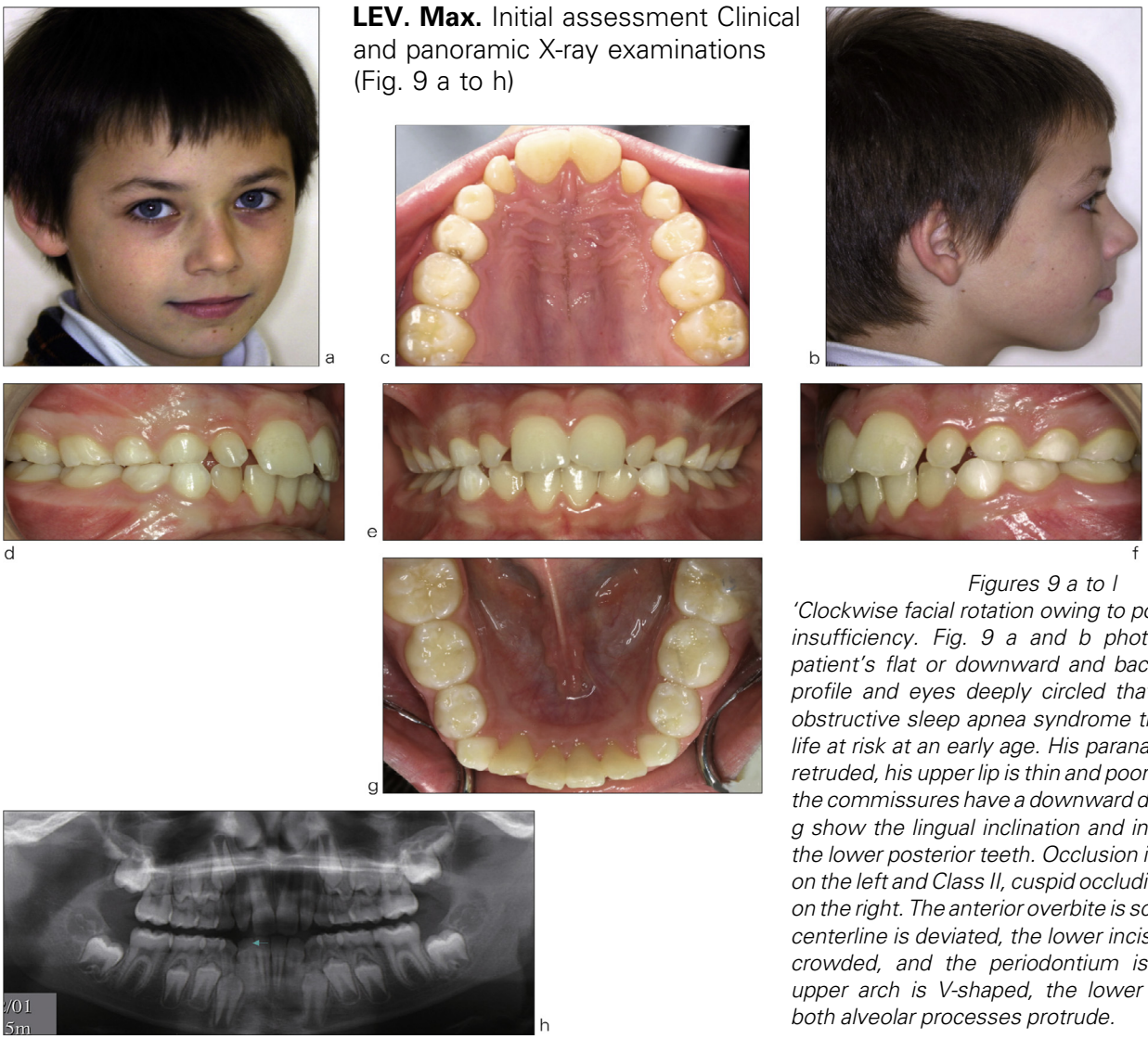
Facial divergence, posterior vertical ramal insufficiency or insufficient counter-clockwise rotation of the mandible.

Class I skeletal with bimaxillary alveolar advancement superimposed on bimaxillary retrusion.

Dental crowding in the mid and posterior sectors of the arches.

Posterior mandibular compression.

LEV. Max. Initial assessment Clinical and panoramic X-ray examinations (Fig. 9 a to h)



Figures 9 a to l

'Clockwise facial rotation owing to posterior vertical insufficiency. Fig. 9 a and b photographs show patient's flat or downward and backward inclined profile and eyes deeply circled that testify to his obstructive sleep apnea syndrome that had put his life at risk at an early age. His paranasal regions are retruded, his upper lip is thin and poorly outlined, and the commissures have a downward droop. Fig. 9 c to g show the lingual inclination and infraocclusion of the lower posterior teeth. Occlusion is Class I dental on the left and Class II, cuspid occluding with cuspid, on the right. The anterior overbite is scanty, the lower centerline is deviated, the lower incisors are slightly crowded, and the periodontium is delicate. The upper arch is V-shaped, the lower U-shaped and both alveolar processes protrude.

LEV. Max. Initial radiological assessment and Delaire analysis (Fig. 9 i to l).

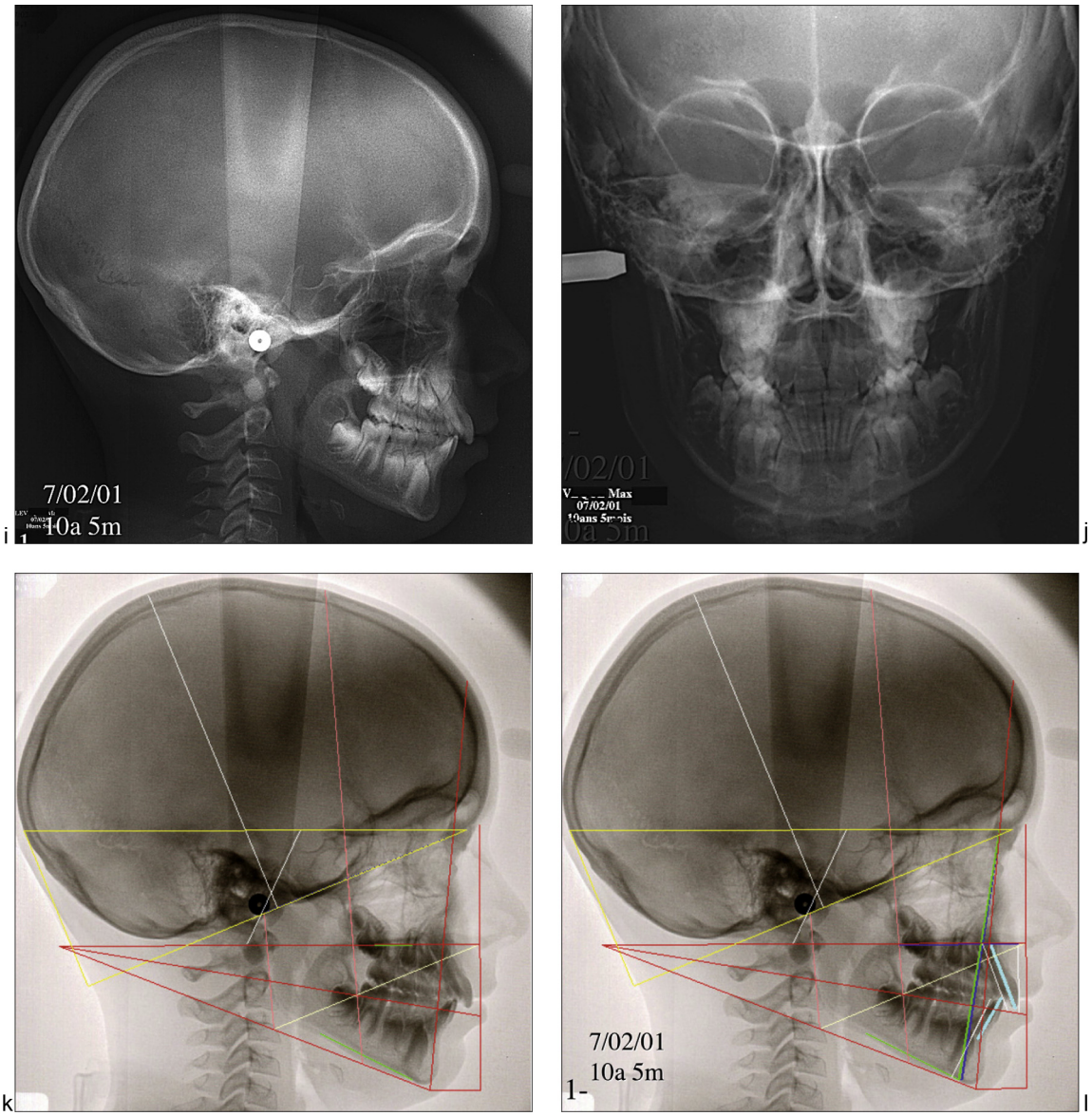


Fig. 9 h: the panoramic film shows rotated maxillary premolars with compression of enfolding of the dental lamina. The eruptive trajectory of the upper left cuspid is disturbed. Fig. 9 i profile cephalogram shows insufficient ramal height with deformed condylar head accompanied by insufficient bimaxillary counter-clockwise rotation and insufficient bimaxillary advancement leading to posterior compression. This ''compression of the articulation'' as Delaire has called it has the posterior border of the ramus backed up in relation to the anterior border of the atlas. There is posterior dental crowding with the buds of the mandibular third molars jammed above the unerupted crowns of the lower second molars. The tongue is compressed to the rear blocking the pharyngeal opening that leads into extremely narrow pharyngeal airways. The anterior overbite is scanty and the posterior teeth buccal are in infraocclusion and tilted lingually. Fig. 9 j, the frontal cephalogram shows the narrowness and the blockage of the nasal passages with a deviation of the septum and hypertrophy of the inferior turbinates. The high position of the buds of the lower second and third molars is also visible. There is asymmetry and lingual inclination of the mandibular buccal segments. The roots of the maxillary posterior teeth are insufficiently inclined buccally. Fig. 9 k and fig. 9 l show the ramal insufficiency and poor formation of the condyle heads, the clockwise rotation of the occlusal and mandibular planes, and bimaxillary retrusion with protrusion of the alveolar processes of both upper and lower arches. Note that the tongue has assumed a high position because the teeth are in occlusion for the film taking. But it is still obstructing the airways.

LEV. Max. (Fig. 10 a to l).

a b c

Figures 10 a to c

Assessment of intraoral photographs. *In the absence of any dental skeletal overjet or distinct overbite there is a Class I occlusion on the left and a Class II cuspid relationship on the right one might think that Herbst rods carried on a splint would not be indicated. But an analysis of the facial insufficiency, despite the occlusion being Class I skeletal, which has caused a lack of space for the tongue and the pharyngeal airways shows that these devices would, in fact, be helpful. Note that the vertical transverse intercuspation is inadequate because of the vertical posterior insufficiency and the condylar expression is weak. Accordingly the orthodontic unlocking was begun with a pre-orthopedic phase of treatment with Herbst rods.*

d e f

Figures 10 d to f

Orthopedic treatment phase with modified Herbst rods in a splint, (with occlusal pathways, a plastic inclined plane bonded to lower incisors, and a rapid palatal expander) *As soon as they were set in place the Herbst rods began to encourage the tongue to assume a vertical posture because 1) they were creating space for it by lowering and advancing the mandible, 2) they were interposing themselves between the tongue and the cheeks, 3) they were also occupying inter-occlusal space the tongue had been slipping into, 4) they were forcing the tongue to hold itself erect to push the unretentive splints back up against the palate splitter, which was lying over the palatal mucosa, and 5) they were working with the palate splitter to encourage nasal breathing.*

g h i

Figures 10 g to i

Post-orthopedic adaption phase with Bonnet nocturnal lingual envelope and Korn lip bumper. *In cases of tongue and ramal insufficiency the Herbst rods through their occlusal pathways and their encouraging a vertical tongue position stimulate renewed ramal growth and restore ramal homeorhesis. The Herbst rods with their occlusal pathways block the alveolar processes from growing vertically and buccally. There is also a need to assure secondary vertical anchorage of the splints that minimizes the mesial slippage of the lower arch, teeth and alveolus that is a part of Class II correction. But because of this the buccal segments, particularly in the mandible, cannot effectuate the vertical transverse ''raising'' in conjunction with the correction of ramal height and temporary lateral open bites may appear because alveolar vertical growth hasn't yet taken place. This will occur during the dento and tempero-mandibular post-orthodontic adaptive phase.*

i k l

Figures 10 j to l

Post-treatment intraoral photos when patient was 18 years and 10 months old. Neither fixed appliance nor retention were used in this cased. Note changes in status of the alveolar processes and the alignment of the anterior teeth.

LEV. Max. (Fig. 11 a to f).

a b c

Figures 11 a to c

Notes the flat forehead, the receding paranasal regions forming a facial concavity, the deep rings around the eyes, the thin upper lip with poorly marked borders, the commissures drooping slightly, the short sub-mental distance with a tendency toward a double chin.

d e f

Figures 11 d to f

The facial type remains flat, cisfrontal, with an obtuse naso labial angle, but considerable rounding and advancement of the forehead and the paranasal regions, with greatly reduced circles around the eyes, increase in the vermillion border and rim of the upper lip, raising of the commissures, and lengthening of the sub-mental distance.

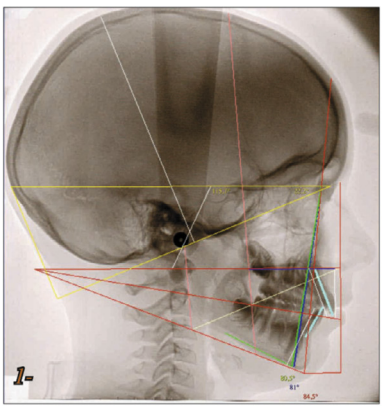
LEV. Max. Superimpositions on Tongue, ramal, occlusal, cortical lines on successive cephalograms show the bimaxillary descent and advancement (Fig. 12 a to c).

Figure 12 a

The Delaire analysis shows:

- *sagittally, the insufficient advancement of FM, Np, and Me (FM-Np dark blue, FM-Me green). Class I with bimaxillary retrusions with both alveolar processes advanced. (Incisors in light blue, ideal incisal inclination in white)*
- *vertical insufficiency with short rami and deformed condylar head*

HYPERDIVERGANCE of the MANDIBULAR PLANE. In sum, this patient's ''facial insufficiency'' has caused narrowness of the pharyngeal opening as well as anterior, mid-arch, and posterior dental crowding.



Figures 12 b to e

Profile cephalograms 1, 2, 3, and 5 (Number 4 is not available. METHOD OF CEPHALOMETRIC TRACING SUPERIMPOSITION (See explanation for case 3 MON. Val.)

Note the extreme narrowness of the oro-pharyngeal opening on film 1. The patient had suffered from life-threatening symptoms of Obstructive Sleep Apnea at an early age, so severe that his parents had to take turns keeping his head upright during sleeping hours. Surgeons had performed an adenoidectomy, a tonsillectomy, and, four years before the first cephalogram was taken, another corrective tonsillectomy. But there was no improvement in the narrowness of the upper airways. We began orthopedic therapy aimed at stimulating tongue, ramal, occlusal and cortical growth with Herbst rods later assisted by a Bonnet lingual envelope and Korn lip-bumpers adapted to post-orthopedic tempero-mandibular and dental occlusal treatment that accomplished:

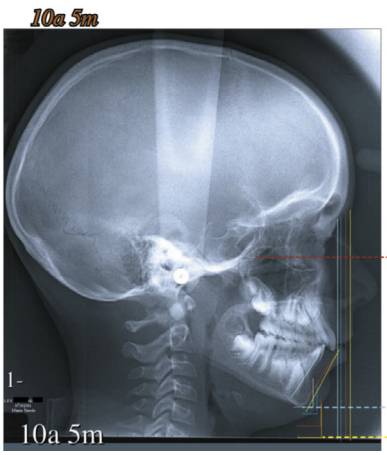


Figure 12 b

Profile cephalogram 1: pre-treatment assessment.

Note the posterior mandibular compression that Delaire described, with the posterior border of the ascending branch not tangent to the anterior border of the atlas, the narrowness of the pharyngeal aperture, the mid-arch and posterior dental crowding, and the posterior status of FM.

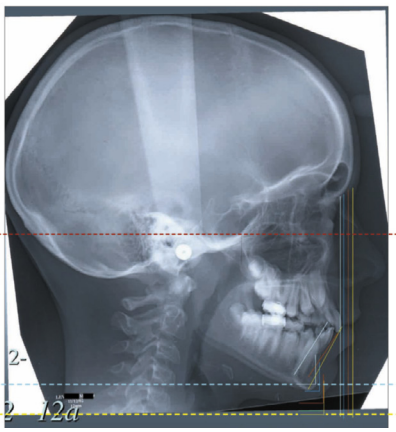


Figure 12 c

Profile cephalogram 2: removal of Herbst rods even though the patient's Class II tendency was quite slim.

Beginning of the post-orthopedic tempero-mandibular and dental occlusal adaptation phase in conjunction with use of nocturnal lingual envelope and lip-bumpers. Note that the nasal and oro-pharyngeal apertures are beginning to enlarge and that the posterior mandibular and dental decompression is starting.

LEV. Max. (Fig. 12 d to f)

1/A descent of the mandible
The horizontal series of films 1, 2, 3, and 5 are all aligned the tangent to the upper border of the pterygo-maxillary fissure shows that the first and the principal response to therapy is a restoration of vertical tongue and ramal growth and, when nasal breathing is well established, a return to ramal homeostasis. With it the palate descends and the oro-pharyngeal aperture widens. Finally, ramal growth stimulates descent of the mandibular canal that carries the buds of the lower third molars with it, behind the lower second molars, allowing them t erupt normally.
2/The cortical fronto-maxillary advancement is the second most profound response to orthopedic growth stimulation. Here vertical, the redistribution of films 1 and 5, is still aligned on the pterygo-maxillary fissure. Note how the dotted vertical red line brings into focus the sagittal maxillary advancement that increases available arch length for uncrowded eruption of the cuspids when patient is 9, second molars at 12 and third molars between the ages of 18 and 20.
3/Mandibular advancement that follows the decompression of the tempero-mandibular joint with elongation of the body of the mandible. (The posterior border of the ramus abuts anterior border of the atlas in film 5 because the patient's head is held in extension). There is now increased room for the tongue and the pharyngeal aperture.

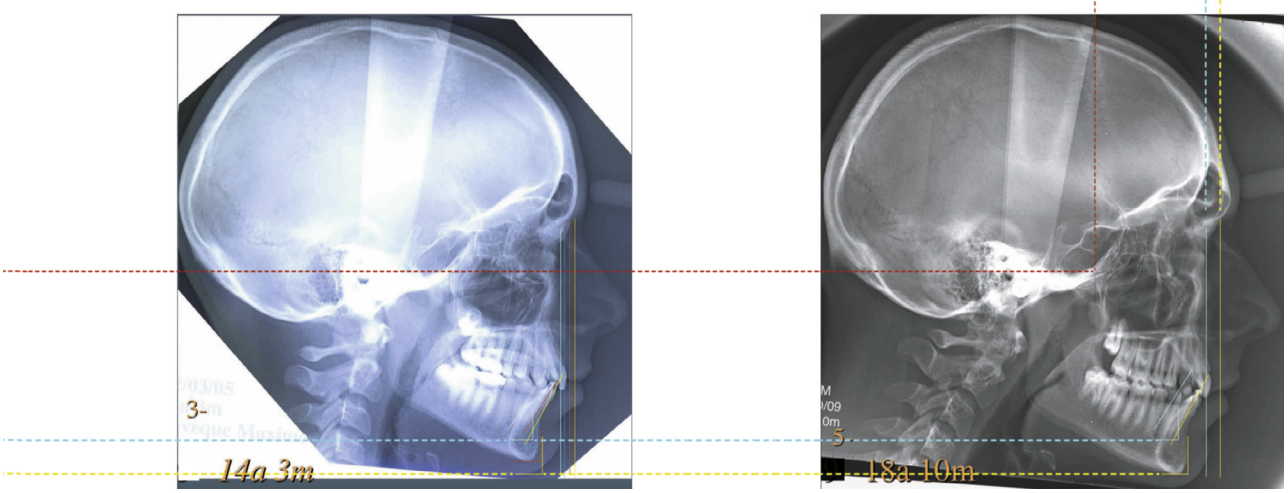


Figure 12 d
Profile cephalogram 3: end of retention in conjunction with lingual envelope and lip bumpers.
Note the continuing improvement of the patient's ventilation apparatus through enlargement of the nasal and oro-pharyngeal apertures. But tongue posture is still unacceptably low and incisal repositioning has not yet taken place. At this time we requested an otolaryngological assessment. (cf plate 14).

Figure 12 e
Profile cephalogram 5: end of retention, check-up film of third molar eruption.
Note continuing enlargement of nasal and oro-pharyngeal apertures. A few months after film 3 was taken and otolaryngologist had operated on the lower turbinates and the nasal fossas. Tongue posture is now acceptably high and incisal repositioning has taken place.

LEV. Max. Delaire's orthognathic analysis and superimposition of the tongue-ramal-occlusal-cortical lines of the descent of the rami and the palate and COUNTER-CLOCKWISE OCCLUSAL AND MANDIBULAR ROTATION (fig. 13 a to c).

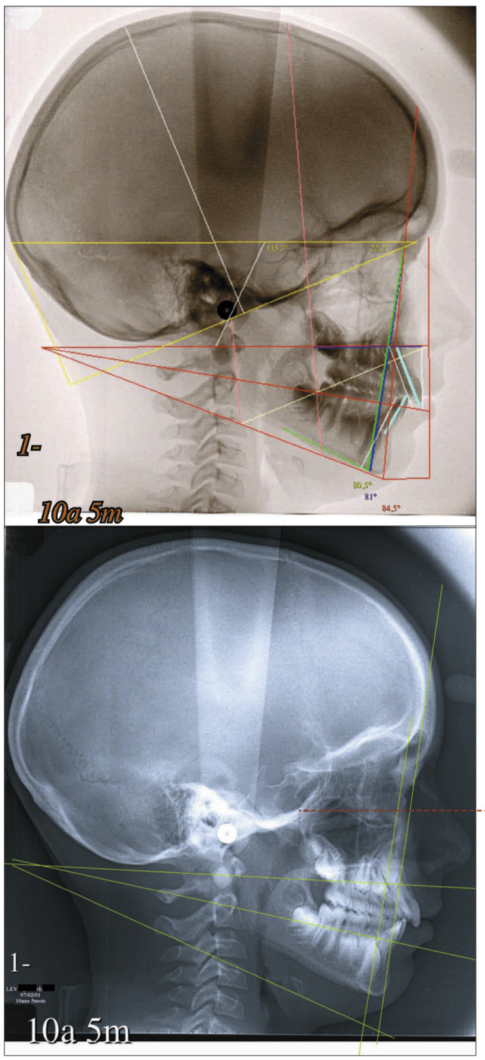


Figure 13 a
In this tracing of cephalogram 5 we constructed the three lines of the masticatory apparatus, the palatal plane 5, the occlusal plane 5, and the mandibular plane 5, of Delaire's Me-No, and the anterior maxillary pillar 5, FM, Np. Then we copied and transferred them to films 1, 2, and 3.
In this case, for teaching purposes, we also traced the anterior maxillary pillar on film 1 and copied and transferred it to films 2, 3, and 5.

Anterior maxillary pillar 5
traced on film 5
and copy-transferred to film 2

Anterior maxillary pillar
traced on film 1
and copy-transferred to film 2

Figure 13 b
Profile cephalogram 1: assessment.
Note: the posterior mandibular compression that Delaire described, the posterior border of the ascending ramus not tangent to the anterior arc of the atlas, the narrowness of the pharyngeal aperture, the mid-arch and posterior dental crowding, and the posterior location of FM.

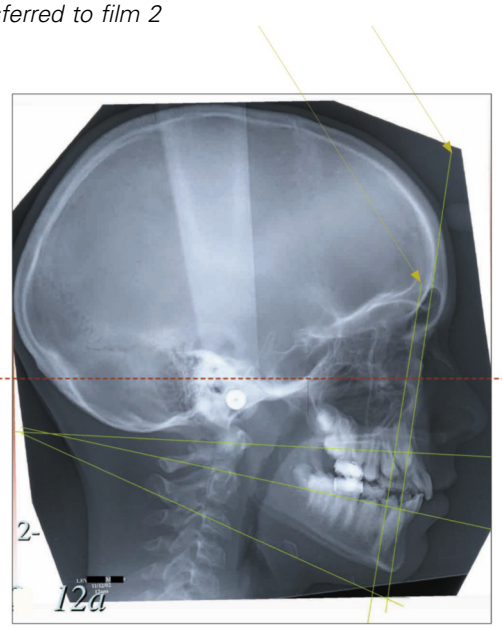


Figure 13 c
Profile cephalogram 2: taken when Herbst rods, employed despite lack of a real initial Class II configuration, were removed.
Beginning of the post-orthopedic tempero-mandibular and dental occlusal adaptation phase in conjunction with use of nocturnal lingual envelope and lip-bumpers. Note that the nasal and oro-pharyngeal apertures are beginning to enlarge and that the posterior mandibular and dental decompression is starting.

LEV. Max. (Fig. 13 d to f).

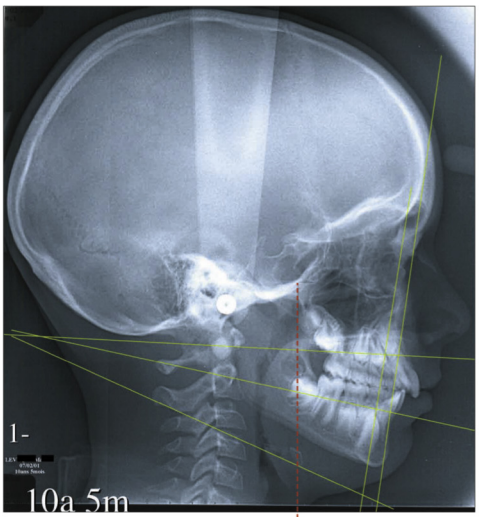
We can observe on film 5:

- *the line denoting anterior maxillary pillar 5*
- *the line denoting anterior maxillary pillar 1*

These precise comments can be made about film 5:

- *the unerupted upper right and left canines are located mesial to the anterior maxillary pillar 5*
- *the unerupted upper right and left first bicuspids are located distal to the anterior maxillary pillar 5 but are mesial to the anterior maxillary pillar 1*

This means the anterior maxillary pillar 1 has advanced the width of a bicuspid between the time film 1 was taken and the time film 5 was taken.
And we can see on film 1, superimposed on film 5, that at the age of 10, the upper cuspids were located between PMA 1 and PMA 5, that is mesial to PM 1.
In sum, that the tongue-ramal-occlusal-cortical therapy has caused a mesial migration of the anterior maxillary pillar and the maxillary canines of the width of a premolar. And this maxillary movement has generated sufficient space for proper eruption of the maxillary canines and also provided enough space for decompression of the posterior mandibular sector and allowed room for good tongue positioning as well as space for the oro-pharyngeal airways.
Before occluso-cortical growth can begin, the tongue ramal stimulation must occur so that the palatal, occlusal, and mandibular planes can descend and ROTATE COUNTER-CLOCKWISE. Note how the lower third molars have moved behind the second molars before erupting.



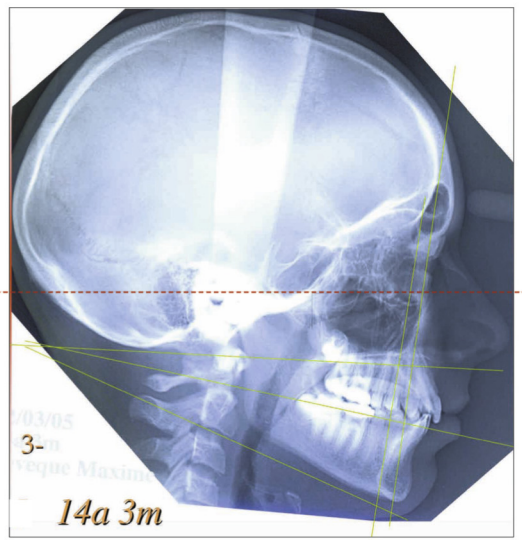


Figure 13 d
Profile cephalogram 3: end of retention in conjunction with nocturnal lingual envelope and lip-bumpers.
Note the continuation of improvement in ventilation that will accompany the enlargement of the nasal and oropharyngeal apertures. However at this point the tongue posture is still low and incisal repositioning has not yet taken place. We asked for an otolaryngological assessment (cf plate 14).

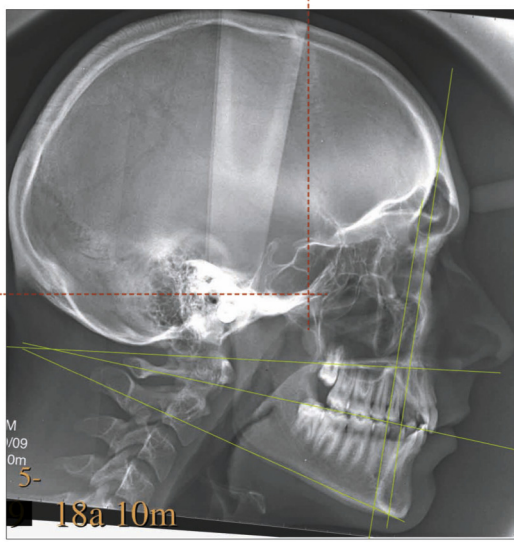


Figure 13 e
Profile cephalogram 5: post-retention.
Note continuation of enlargement of the nasal and oropharyngeal apertures. An otolaryngological procedure had been accomplished for the inferior turbinates and the nasal fossas a few months after film 3 was taken. Tongue posture appears to be high and the incisal repositioning has taken place.

LEV. Max. Frontal cephalograms (fig. 14 a to e)

Fig. 14 a. Frontal cephalogram 1 – orthodontic assessment.

Orthodontic treatment plan: *We decided to use Herbst rods because of the severity of the bimaxillary retrusion combined with posterior vertical, insufficiency. (cf plate 12), keeping a watchful eye on possible appearance of undesirable side effects in case tongue posture did not become more vertical;*

1/there was a risk facial divergence might be aggravated by a clockwise rotation of the mandible

2/there was a risk of non-skeletal simultaneous bimaxillary advancement with a mesial dental and alveolar mandibular drift with increase of labial inclination of the lower incisors. Here again, a vertical posture of the tongue was vital as a component of improved nasal ventilation.

Otolaryngological treatment plan: *patient had had previous adenoidectomy and tonsillectomy with a revision of the adenoidectomy 4 years ago.*

The ENT assessment: X-ray showed nasal blockage that would require constant parental vigilance. They had to be ready to assist child in breathing night and day should problems persist even though Herbst treatment might be beginning to be effective.

Fig. 14 b. Frontal cephalogram 2: re-evaluation at end of Herbst phase and institution of nocturnal lingual envelope and lip-bumpers.

QUESTIONS ABOUT NASAL VENTILATION. The frontal and profile 2 cephalograms (cf plate 12) show lower first molars tipped back from lip-bumper action, which bears witness to an occlusal deficiency that will require an eventual uprighting of these mandibular molars. The profile film reveals that there has been no repositioning of the lower incisors.

ENT STATUS: After having been enlisted as guardians of their child's breathing help, the parents again consulted the otolaryngologist who decided that in the absence of any frank airway blockage, no immediate ENT intervention was indicated.

However, as orthodontists, our clinical impression was that the patient was a mouth, or mixed, breather and that the frontal head film showed evidence of nasal blockage, a situation we felt demanded careful monitoring.

Fig. 14 c. Frontal cephalogram 3: re-evaluation of retention with lingual envelope and lip-bumpers showed (cf plate 12) showed continued low tongue posture as did the profile film, as well as continued distal tipping of the mandibular first molars, lack of incisal repositioning, and, despite use of lingual envelope and lip-bumpers, an incomplete reduction of the ''posterior articular compression.''

ENT assessment: we asked for a consultation with a different otolaryngologist, one who was well-informed about genetic influence of morphology, who decided to cauterize the left and right inferior turbinates after light premedication and under local anesthesia, being careful to avoid any encroachment on the septal spur. The nasal situation would be re-evaluated when the patient was 18 years old.

Fig. 14 d. Frontal cephalogram 4. Orthodontic treatment was completed at this time and no retention was planned. Check-up films showed the nasal fossas were patent and the lower incisor position, the posterior mandibular compression, and the posterior mandibular crowding were all corrected.

ENT ASSESSMENT: surgery on the nasal fossas had been successful as the radiographs showed. The profile head film 4 (cf plate 12) showed the occlusion of the first and second molars had improved and that the advancement of fronto-maxillary region was proceeding.

Note: the relation of the lower third molars to the second molars had improved and they were in good position for eruption.

Fig. 14 e Frontal cephalogram 5. Orthodontic treatment was completed at this time and no retention was planned. Check-up films showed the nasal fossas were patent and the lower incisor position and the posterior mandibular compression were corrected. Third molars had erupted.

Profile cephalogram 5 showed that the lower incisors had finally assumed their correct position, the fronto-maxillary region was continuing to advance, and the ''posterior mandibular compression'' was reduced, but the patient's cervical posture when this film tended to enhance the appearance of this phenomenon.

LEV. Max. Panoramic films (fig. 14 f to j)

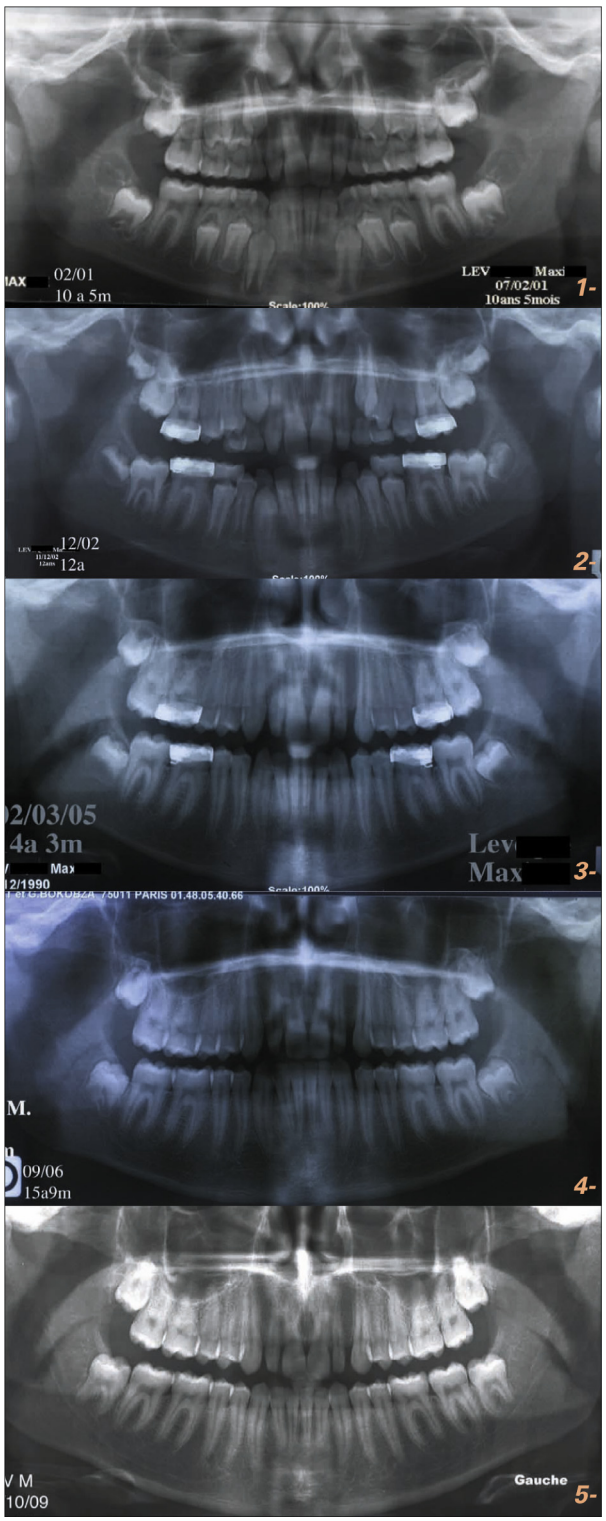


Fig. 14 f Panoramic film 1: Orthodontic assessment.
We decided to begin treatment with modified in three dimension Herbst rods in splints early because of the patient's severe impairment of nasal breathing, that is during the time of the stable mixed dentition rather than later.
The upper cuspids were delayed in eruption.
Note the high position above the erupting second molars of the sacs awaiting the formation of the lower third molars, caused by insufficient posterior vertical for which slow ramal growth and poor tongue posture are responsible.

Fig 14 g Panoramic film 2: re-evaluation after discontinuance of Herbst rods and institution of nocturnal lingual envelope and lip-bumpers.
Remnants of deciduous crowns, usually lost when Herbst rods are used, linger in the arch.
Front-maxillary advancement had contributed significantly to the opening spaces to accommodate eruption of the upper cuspids.
Ramal descent is beginning to help the lower third molars to move behind the erupting second molars.
We had the remaining deciduous teeth extracted to facilitate alignment of the mandibular incisors in response to improved tongue posture. Improved nasal ventilation contributed to this phenomenon. The upper second molars are erupting more slowly than the mandibular second molars.

Fig 14 h Panoramic film 3:
Re-evaluation of retention associated with nocturnal tongue envelope and lip bumpers.
Lower third molars are continuing to move into position behind fully erupted second molars as tongue ramal growth proceeds.

Fig 14 i Panoramic film 4:
Orthodontic treatment is completed. No retention is planned.
This film records the remaining posterior crowding as the lower third molars erupt along the distal surfaces of the second molars and the upper third molars are slower in erupting.

Fig 14 j Panoramic film 5:
Orthodontic treatment is completed. No retention is planned.
The lower third molars have assumed their position in the arch as the upper third molars still lag behind them.

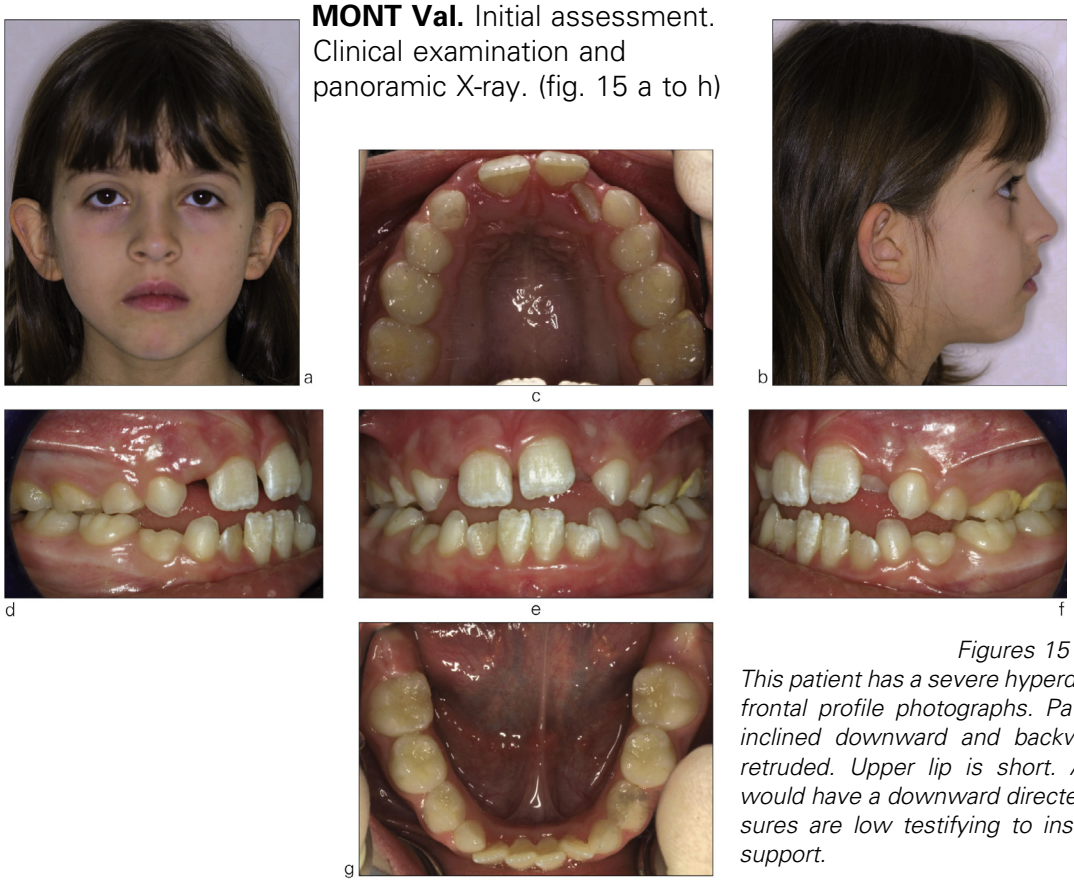
CASE N^0 3 – MONT. Val: ENT treatment, removal of hypertrophied tonsillar and adenoid tissue at the beginning of orthodontic treatment

A case of severe hyperdivergence with insufficient posterior vertical growth and narrow up airways.

Severe arch length discrepancy dental crowding.

Class II skeletal malocclusion with upper and lower jaw retrusions and occlusion in Class III.

MONT Val. Initial assessment. Clinical examination and panoramic X-ray. (fig. 15 a to h)



Figures 15 a to l

This patient has a severe hyperdivergence. Fig. 15 a and b: frontal profile photographs. Patient's forehead is flat or inclined downward and backward. Paranasal region is retruded. Upper lip is short. An inter-commissure line would have a downward directed concavity. The commissures are low testifying to insufficient maxillary cortical support.

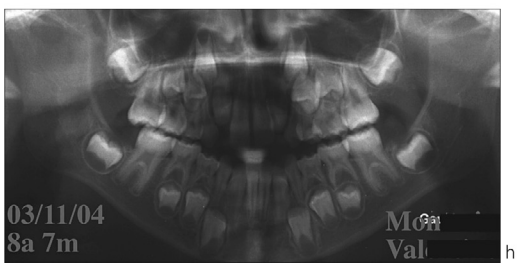


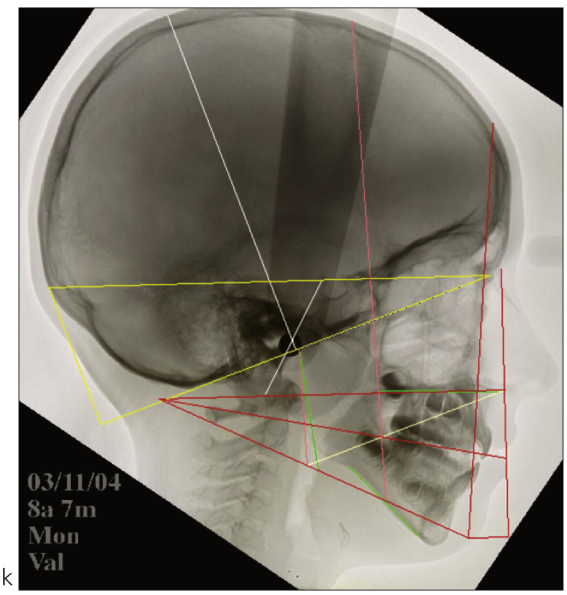
Fig. 15 c to g: Tongue is held low and forward. The teeth of the lower buccal segments are in infraocclusion and are severely tipped lingually. Lateral and anterior open bites are present. Dental occlusion is Class III tendency. Because of crowding and midline deviation, the incisor teeth have not become well aligned. There is insufficient space for eruption of the upper lateral incisors.

Fig. 15 h: This panoramic film shows the mesial tilting of the lower cheek teeth, an indication of the lingual inclination and low alveolus cause by posterior vertical insufficiency. There is anterior and mid-arch crowding.

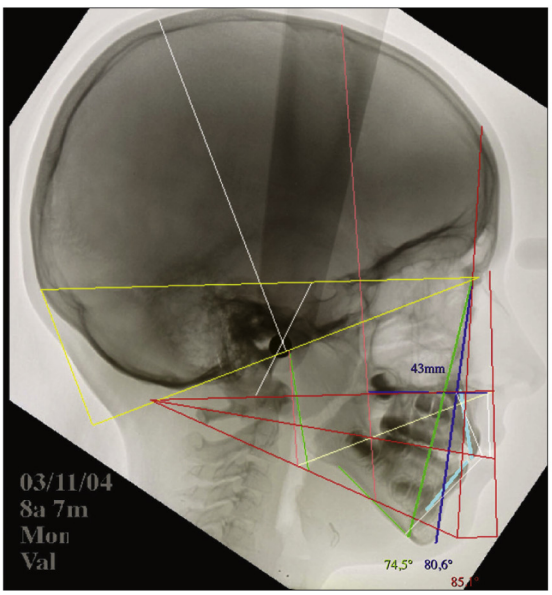
MONT. Val. Initial radiographic assessment and Delaire analysis (fig. 15 i to l).

i

j



k



l

Fig. 15 i, k, l: view of the hypertrophied adenoidal tissue in contact with the tail of the inferior turbinate, owing to inferior posterior vertical height and excessive anterior vertical height with severe clockwise tipping of the occlusal and mandibular planes. Posterior situation of FM, severely retruded maxilla (FM-Np in dark blue 80.6^0 and a more severely retruded mandible (FM-Me in green at 74.5^0). Brachymaxilla, 43 mm in length instead of the normal 47 mm for 9 year-olds) and brachycorpus of mandible. Naso-pharyngeal apertures are narrow.

Figure 15 j: incomplete occlusion of buccal segments because of lingual alveolar tilting related to posterior vertical insufficiency, mandible shifted to left. The nasal passages appear blocked at the level of the inferior turbinates. In sum: ''facial insufficiency'' in three bimaxillary dimensions resulting in insufficient space for change of dentition, for the tongue, and for the nasal and oropharyngeal airways.

MONT. Val. Intraoral photographs (fig. 16 a to o)

Figures 16 a to c

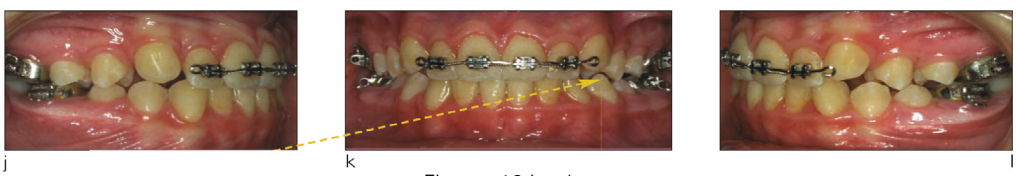
Assessment. *We asked oral surgeon to extract 83 and 63 and requested an ENT consultation before beginning orthodontic treatment. Note the low and forward tongue position and lack of space for upper laterals, the Class III tendency of the anterior teeth, the anterior and lateral open bite, and the deviation of the lower centerline to the left because of mandibular asymmetry.*

Figures 16 d to f

We used only a nocturnal lingual envelope as a treatment appliance six months after otolaryngological treatment to close the open bites. All temporary canines were extracted. Note change in tongue posture achieved by envelope therapy and the closure of the open bites due to COUNTER-CLOCKWISE ROTATION of the OCCLUSAL PLANE, disappearance of the anterior Class III tendency, alignment of the incisors, and midline correction.

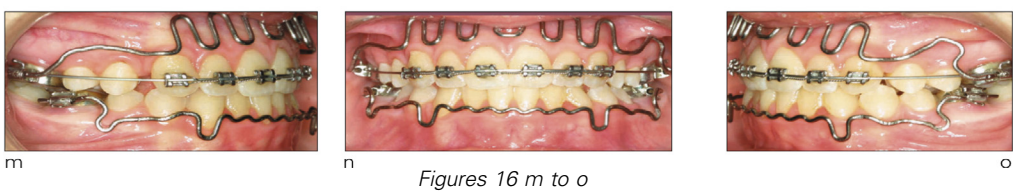
Figures 16 g to i

Joint treatment of lingual envelope, lip –bumpers and Mask of Delaire. *After one year of envelope therapy only, we added the lip-bumpers, and an anterior sectional arch to support a Delaire mask to the appliance system. Note the quality of the anterior occlusion especially the good covering of the maxillary incisors, the occlusion of 24 and 34, and the space available for the upper cuspids. Patient's persistent use of oral habits resulted in the lip-bumper iatrogenically causing excessive mesio-buccal rotations of the lower third molars.*



Figures 16 j to l

Joint use of envelope and lip-bumpers. *Patient persisted in oral habits, especially:*
1/cheek sucking or contraction causing lingual tilting of lower posterior teeth;
2/low and anterior tongue posture made it difficult to correct the Class III dental relationship in a Class II skeletal framework. The upper first premolars have erupted with an excessive mesio-buccal rotation. The upper and lower left first bicuspids are coming into occlusion.



Figures 16 m to o

A full-banded, bonded appliance is being installed to deal with mesial drifting of the posterior sectors. *The maxillary lip bumper will be removed so that the upper temporary teeth can come forward. A second lower lip bumper will be placed following the loss of the first. Then the second lower lip bumper was lost.*

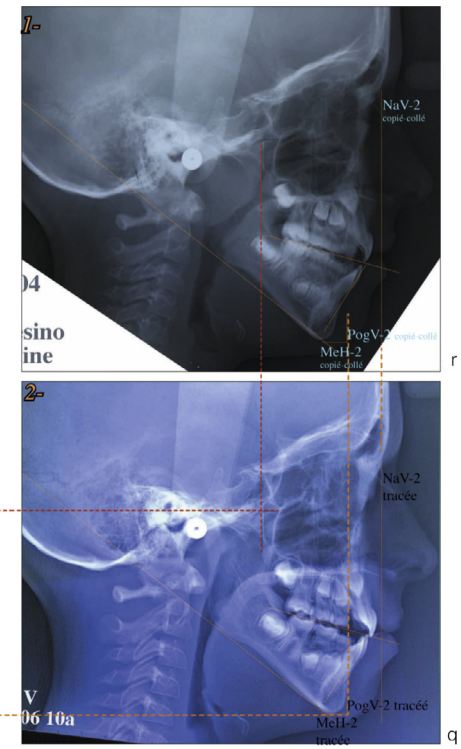
MONT. Val. Initial profile cephalograms, one following the Bonnet nocturnal lingual envelope therapy that came after the ENT intervention

Cephalogram 1. Assessment: adenoidal tissue is in close proximity to the inferior turbinate
Cephalogram 2 – *After otolaryngological intervention: the removal of tonsillar, adenoidal, and turbinate tissue plus treatment with nocturnal lingual envelope only, and extraction of all temporary cuspids (cf. plate 16 a to f).*
SUPERIMPOSITIONS Tongue-rami-occlusal-cortical
The observation orthogonal lines of descent and advancement of the mandible and maxilla.
1/NaV-2 a vertical line drawn from Na-2 or Na from film 2, extended downward to the mandibular symphasis, then copied-traced on film 1, to check:

- *the advancement of pogonion-1, here insignificant because lateral occlusion is still not strong.*
- *the advancement of the incisal block 1/NaV-2 here significant and accomplished without the orthopedic assistance of a Delaire mask, but, without doubt, resulting from vertical re-positioning of the tongue thrusting against the palate and the anterior teeth.*
- *2/PogV-2, a vertical line drawn from Pog-2, or Pog of film 2, then copy-traced on film 1, to check:*
- *advancement of Pog-1 in relation to PogV-2, here significant, and accomplished without the aid of Herbst rods, without doubt, resulting from vertical re-positioning of the tongue thrusting against the palate, a kind of ''tongue-rod effect.''*

3/MeH-2, a horizontal line drawn from Me-2, or Me tongue-rami-occlusal-cortical, the lowest point of the mandibular symphasis on film 2, then copy-traced on film 1, to check:

- *the descent of the mandibular symphasis, here meager, even though this is a case of hyperdivergence. PogV-2 and MeH-meet and close the mandibular symphasis square.*
- *Films 1 and 2, aligned vertically, at the right on the plate, clearly show the sagittal antero-posterior changes of simultaneous bimaxillary advancement, equivalent or different depending on the case. Line Pog-2, first traced on film 2 and the one then copy traced on film 1, are joined together by vertical dotted line, PogV-2-Extended-Vertically as the new sagittal symphasis position. Having become very clear, the amount of advancement of Pog-1, or the mandibular symphasis 1, has reached the PogV-2-Extended – Vertically, for a new sagittal position of the symphasis.*
  Here, in this case of severe hyperdivergence, where the symphasis holds at 74^{0}, we can see that with only the therapeutic use of a nocturnal lingual envelope, after ENT treatment, the mandible has advanced significantly, and without the descent that we shall see later.



- *On films 1 and, aligned horizontally, at the base of the plate, we can clearly visualize vertical development, the simultaneous bimaxillary descent, differential or similar, depending on the case. The line MeH-2, traced first on film 2, and then copy-traced on film 1, are joined by a horizontal dotted line, Me-H-2 Extended-Horizontally.*
- *Having become very clear, the amount of descent thatMe-1, or the mandibular symphasis 1 has accomplished to reach the line Me-H-2-Extended-Horizontally, a new vertical symphasis position. Here, in this case of great hyperdivergence, we can observe an almost complete arrest of the descent of the mandibular symphasis. In sum, the mandibular symphasis has almost stopped descending, and is moving almost exclusively forward a substantial amount, simultaneously with the advancement of the lower sector of the maxilla and the maxillary incisor segment. With the triggering of a simultaneous bimaxillary advancement, the facial insufficiency is, accordingly, reduced. But the oropharyngeal airways remain narrow.*

MONT. Val. Superimposition of profile cephalograms, showing lingual-ramal-occlusal-cortical development, using structural lines for descent of the rami and the palate and the counter-clockwise rotation of the occlusal and mandibular planes (fig. 17 a and b)

We carefully superimposed cephalograms 1, 2, 3, and 4 on tongue-rami-occlusal-cortical landmarks.

- *Horizontally, using the anatomical view of the anterior cranial base, without any rotation between the ''immobilized'' films, or ''locked'' in rotation at about .25^0 using he De Coster line and Power Point dissolve and precise Photo Shop generated rotations*
- *Registered on the pterygo-maxillary fissure*
- *Distributed by the Design program:*
  - *horizontally from the first to the last (1,2, 3, 4)*
  - *vertically on the first, no 1 film and the last, no 4 film.*

On the last cephalogram, 4, we traced these FOUR STRUCTURAL LANDMARKS:

1 – THE ANTERIOR MAXILLARY PILLAR extended to pass through FM midway through the mounting maxillary sector, the anterior lachrymal crest, and the nasal-palatine canal.

2 – THE PALATAL PLANE passing through the posterior nasal spine and the anterior nasal spine.

3 – THE OCCLUSAL PLANE passing along the occlusal surfaces of the lower first molars and the premolar occlusal plane

4 – THE MANDIBULAR PLANE passing through Delaire's Me point and No, the pregonial notch.

The last three planes comprise DELAIRE'S MASTICATORY COMPASS.

The maxillary pillar and the three planes are traced on the last film 4 and then copy traced to the three preceding films, which makes it easy to observe the simultaneous bimaxillary descent and COUNTER-CLOCKWISE ROTATION:

1 – By perusing the four film horizontal series, the observer can note the remarkable descent of the Palatal Plane that reaches, on film 4, a normal level, aligned vertically with the cranial base. This inspection also gives a clear appreciation of this passage and its realism and the precision of this high visibility superimposition method with registration on the points the cranial base that is shown to be rigorously stable vertically while the PALATAL PLANE is making its impressive descent simultaneous with and because of renewed tongue and ramal growth.

Figure 17 a

Cephalogram 1 – orthodontic assessment.

Because of the severity of the facial insufficiency resulting from differential bimaxillary retrusion (FM-Me at 74^0 and FM-Np at 80^0) and the hyperdivergence with insufficient posterior and excess anterior vertical height, we decided to begin treatment with otolaryngological removal of hypertrophied adenoid, tonsillar, and inferior turbinate tissues. We began orthodontic treatment 9 months later anticipating that this surgical intervention would make extraction of permanent teeth unnecessary.

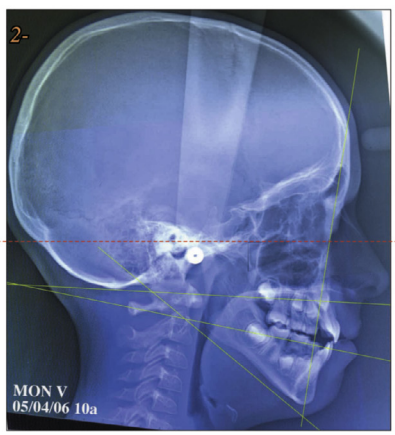


Figure 17 b

Profile cephalogram 2 taken after patient wore a nocturnal lingual envelope as the sole orthodontic appliance for 6 months.

1/The ENT procedure of 27/06/205 had removed excess osseous tissue of the inferior turbinates by electrocoagulation as well as the exuberant adenoid and tonsillar tissues.

2/All temporary canine teeth were extracted

3/The six-month use of the lingual envelope, with clasps, achieved closure of open bites, helped the mandible and maxilla to advance, and retarded descent of the symphasis (Cf pl. 16–18).

MONT. Val. (fig. 17 c to e)

In this vertical series, 1 and 4, we can discern the total vertical trajectory of the palatal plane as well as the correction of its INITIAL DIVERGENCE, which was typical of hyperdivergence cases. It is essential to realize how much the descent of the palatal plane is at the root of the opening naso-pharyngeal aperture. In this case, that widening occurred as a result of the original adenoidectomy, the descent of the palatal plane, and the bimaxillary advancement. The treatment, or the prevention, of obstructive sleep apnea is not, we can see, simply a result of the bimaxillary advancement but also of the other, associated beneficial developments dependent on tongue ramal growth associated with adequate nasal breathing.

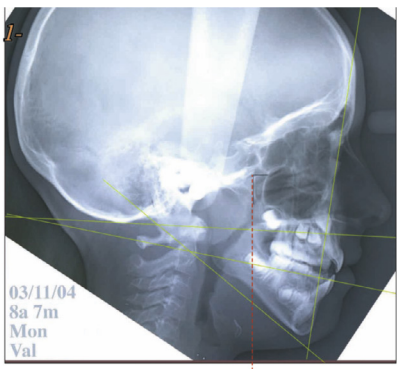
2 – The descent of the occlusal plane and ITS COUNTER-CLOCKWISE ROTATION

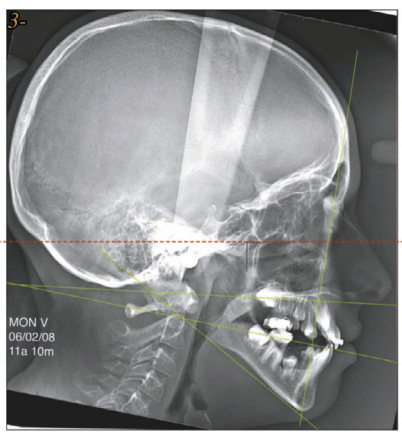
A study of the horizontal series of radiographs, 1, 2, 3, and 4 and then of the vertical series, 1, 4, shows the differential descent of the occlusal plane, which gradually grows greater in its distal portion. There is a major COUNTER-CLOCKWISE rotation of the occlusal plane in correlation with ramal tongue growth and the descent of Gonion. We can also observe the descent of the apices of the lower right first and second molars, still not great enough, with respect to the palatal plane that was stimulated by posterior vertical alveolar growth simultaneous with the cure of the ramal vertical stagnation that the nocturnal lingual envelope authorized with lip-bumpers added later, as was done in this case. (When Herbst rods on modified splints are used, ramal growth spurts occur giving rise to temporary appearance of open bites. Corrective vertical alveolar growth will begin in the post-orthopedic phase in conjunction with the envelope and lip-bumpers. Note that the major counter-clockwise rotation of the occlusal plane moves in the same sense as the ramal related counter-clockwise mandibular rotation as well as the counter-clockwise maxillary rotation that constitutes the fronto-maxillary swinging and ingression advancement that Delaire described.

3 – The descent of the mandibular plane and ITS COUNTER-CLOCKWISE ROTATION

Here again we can clearly discern the differential descent of the mandibular plane under the stimulation of tongue and ramus development in a COUNTER-CLOCKWISE ROTATION.

We can appreciate in the vertical series, 1, and 4, the nearly parallel counter-clockwise rotations of the occlusal and mandibular planes. However, the counter-clockwise rotation of the occlusal plane is more pronounce than that of the mandibular plane.





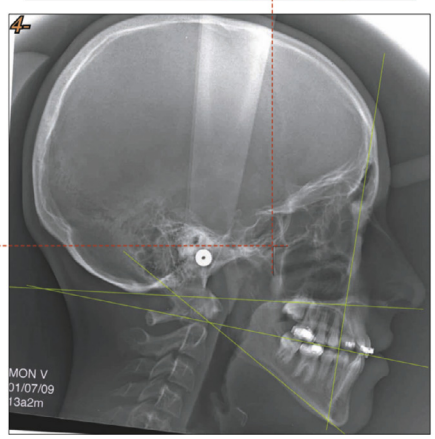


Figure 17 c

Profile cephalogram 3: taken during treatment phase of envelope, bumpers, and Delaire mask.

1/Initial treatment was envelope alone;

2/Treatment continued with envelope and a Salagnac-Delaire mask attached by elastics to upper anterior sectional arch wire;

3/Treatment continued with envelope and bumpers as roots of upper anterior teeth were completing their formation and all four second temporary molars were extracted.

Note how the upper canine teeth have migrated in relation to the structural line of the anterior maxillary pillar traced on film 4, then copy traced to films 1, 2, 3.

Figure 17 d

Profile cephalogram 3: taken during treatment phase of envelope and bumpers, but no Delaire mask. Note the mesial migration of the upper canine teeth bringing their distal surfaces tangent to PMA4. These upper canines preserve the tilted downward and forward tilting of their forward inclined eruption paths. Note the advancement of the ascending branch of the maxilla, otherwise known as the frontal process of maxilla, which reaches PMA4 on the 1, 2, 3, and 4 films and also the position of the upper canines that are in advance of PMA4.

MONT. Val.

Superimpositions on tongue-ramus-occlusion-cortical: structural lines + orthogonal lines (fig. 18 a and b)

Orthogonal lines

We have traced four lines in turquoise blue on film 4, NaV-4, PogV-4, MeH-4 (cf Pl 16) and the long axis of the lower incisors, i4, and then copy traced them to films 1, 2, and 3. On film 1 we traced NaV-1, PogV-1, and MeH-1 in pale blue. Then we trace copied them to films 2, 3, 4.
On film 2, we traced NaV-2, PogV-2, and MeH-2 in orange and then copy traced them to 1 and 3,
On film 3, we traced NaV-3, PogV-3, and MeH-3 in yellow and copy traced them on film 4.
Uniting the horizontal series of films 1, 2, 3, and 4 we traced:

- *a dotted blue horizontal line joining the MeV-4 traced on film 1 to all the MeV-4 copied on films 2, 3, and 4;*
- *a clear blue dotted horizontal line joining the MeV-4 traced on film 4 to all the MeV-4 lines copied on the cephalograms 1, 2, and 3*
  Uniting the vertical films 1 and 4, we traced:
- *a pale dotted vertical line joining NaV-1 traced on film 1 to NaV-1 copied of film 4*
- *a pale blue dotted vertical line joining NaV-4 traced on film 4 to NaV-4 copied traced on cephalogram 1*

Observation of the maxillary and mandibular descents and advancements
Note that with this special method of superimposition dental movements are not separated from skeletal movements. We can, in fact, objectify skeletal movements here and see how the primary movement of a skeletal structure provokes the secondary movement of other entities located between the registration points and the structure under observation. From this point of view, registration on points is quite satisfactory for observing the advancement of Nasion of NaV or the descent of the palatal plane and Gonion. Having said this, let us observe certain other displacements:
1/ Fronto-maxillary and incisal block advancement
We can not only observe but also measure the progressive forward movement of Na, or of NaV-1 to NaV-4 as seen on film 1 to film 4. As children age from 9 to 12 this fronto-maxillary forward thrust amounts to about the width of a premolar tooth,

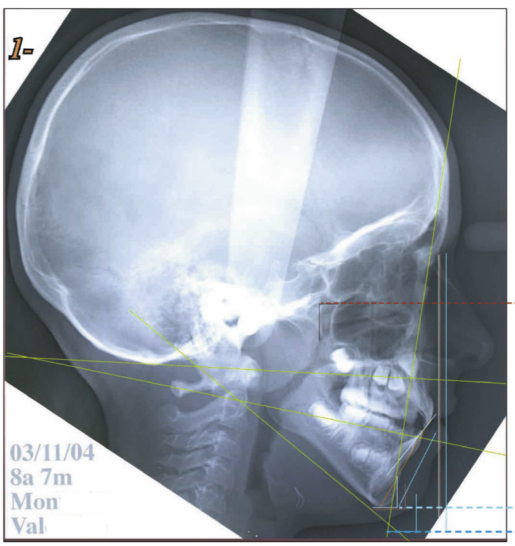


Figure 18 a
Cephalogram 1: orthodontic assessment.
Discern the symphasis square 1 traced in light blue of film 1, then copy traced to the other films, 2, 3, and 4.
Discern on symphasis square 2, traced in orange on film 2 and traced on the other films, 1, 3, and 4. In this way the displacement of the symphasis, a descent and advancement, can be read.

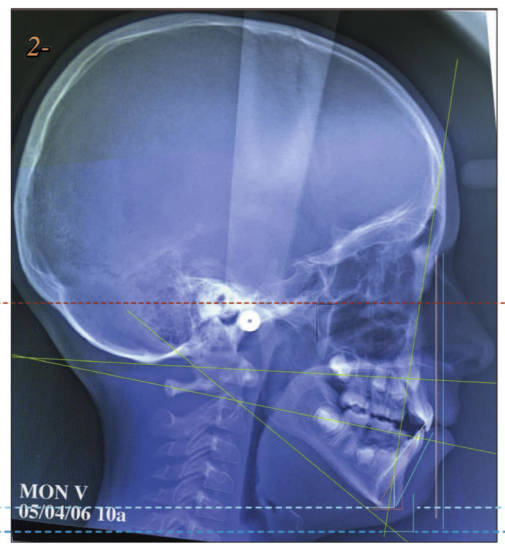


Figure 18 b
Cephalogram 2: after 6 months of lingual envelope therapy only.
The extent of the downward and forward movement of the symphasis can be evaluated by comparing positions of symphasis square 1 to symphasis square 2.
The combined ENT and nocturnal lingual envelope therapy created a movement of almost pure symphasis advancement with virtually no descent. At the same time the maxillary incisor block had advanced in relation to NaV-2 although no orthopedic mask had been employed.

MONT. Val. (fig. 18 c to e)

in our view the essential element in the creation of sufficient space for eruption of the upper canine teeth, without the extraction of other permanent teeth as well as in the acceleration of the change in dentition and the opening of the pharyngeal airways. This supports our contention that space needed for tooth eruption and airway opening is to be found in the anterior sector of the face, not the posterior. This is accomplished by fronto-maxillary advancement in articulation with cortical bone, influenced by occlusal forces expressed in masticatory cycles that must be of full amplitude and include postero-anterior advancement and expansion component. This can most frequently be achieved with the use of an orthopedic advancement mask.
Note that the incisal bloc, as exemplified by the labial surfaces of the upper central incisors, in its attachment to the cortical fronto-maxillary skeletal unit moves forward spontaneously, too, with the advancement of NaV. The labial surfaces of the upper anterior emerge tangent to NaV-4 from a position that was originally distal to NaV-1.
2/Advancement and descent of the mandibular symphasis.

- *The pure advancement between films 1 and 2 (cf plate 16) is appreciable in this case of hyperdivergence.*
- *There was a pure, undesirable, descent of the mandible caused by the patient's failure to wear the nocturnal lingual envelope faithfully.*
- *There was an advancement = Descent displacement of 45^0 between films 3 and 4.*

3/Repositioning of the lower incisors
Note that the repositioning of the lower incisors in this case of dental crowding treated without extractions in relation to the SIMULTANEOUS BIMAXILLARY COUNTER-CLOCKWISE ROTATION
This combined treatment of facial insufficiency with lingual envelope stimulation of tongue ramal occlusal cortical growth at the time of dentition change, accordingly, provides us with a way to solve the dilemma of whether or not to extract permanent teeth to correct problems of dental crowding and arch length position. We can find the space in another way, by creating it.
4/Correction of a Class II skeletal protrusion.
Note that with the fronto-maxillary advancement that is clearly visible in the difference between NaV-1 and NaV-4 the mandible has been allowed to advance even further, thus correcting the protrusion.
Note also, however, that a certain insufficiency and mal-positioning remain and that the tongue is still being held in a low posture in cephalograms 3 and 4.

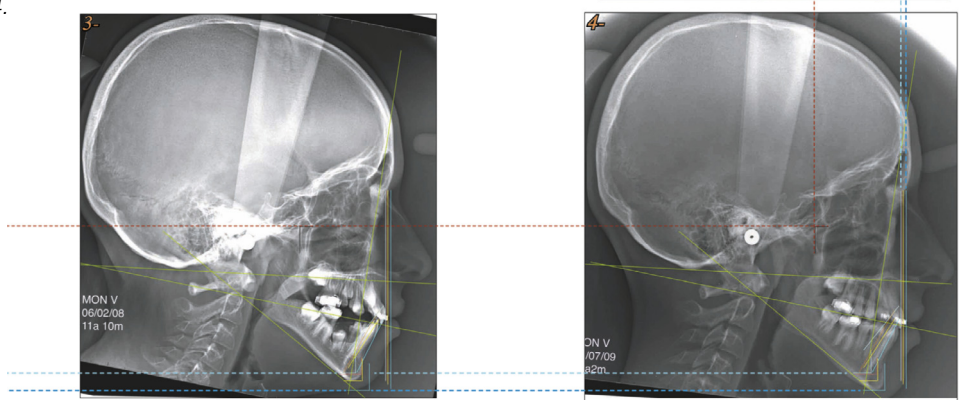


Figure 18 c
Profile cephalogram 3; combined lingual envelope, lip bumper, and Delaire mask treatment
Between the symphasis square 2 in orange and the symphasis square 3 in yellow, in this patient we can see an almost pure symphasis descent, the reverse of what happened between 1 and 2. A simple postural or ventilatory relaxation, with the tongue low and the lips not sealing properly a resumption of mouth breathing, or at best mixed mouth and nasal breathing, explains what is happening. Our procedure of visibility is indispensable to our framing of the patient's situation and our communication with the ENT specialist.

Figure 18 d
Profile cephalogram 4: combined envelope and lip-bumper treatment with no Delaire mask.
Between symphasis square 3 in yellow and the symphasis square 4 in turquoise blue we can now see a classic 45^0 growth of the chin, which means both a dropping down and an advancement. In sum, 3 re-evaluations and 3 three different growth results. The pharyngeal aperture opened, space was created for eruption of the upper canine teeth, and the incisal block followed the fronto-maxillary advancement. But the patient's continued expression of oral habits exerted a deleterious effect on growth. In addition breathing continued, at times, to be mixed oral and nasal. So it was important for the otolaryngologist to persevere in following this patient.

MONT. Val. Frontal cephalograms (fig. 19 a to d)

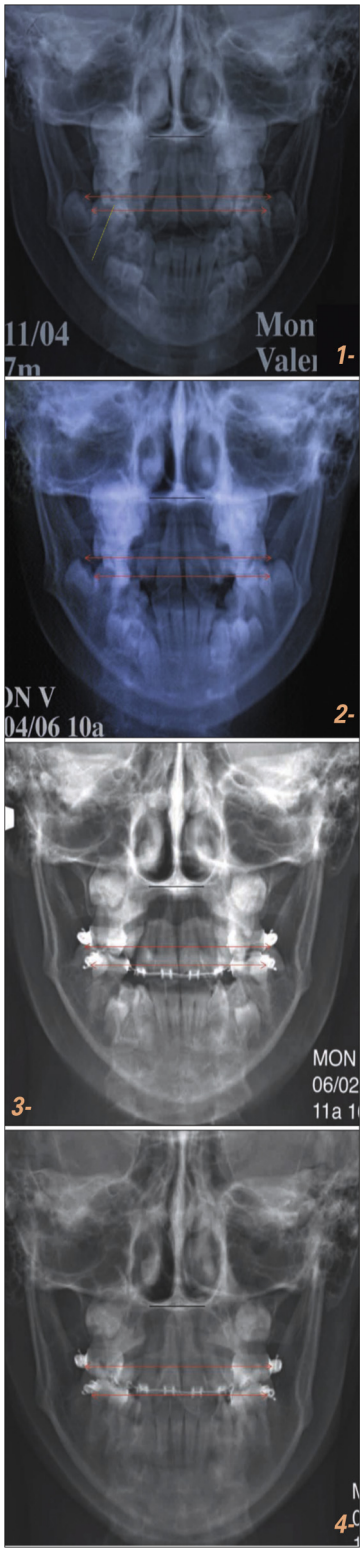


Figure 19 a

Frontal cephalogram 1: orthodontic assessment.

The red arrows show the distances between right and left upper and lower molars, as measured on film 4 and copied to films 1, 2, and 3.

Vertical transverse collapsed of the mandibular buccal segments with the lower first molars tilted by excessive expansion of roots caused by low tongue posture and by lingual tilting caused by the insufficient posterior vertical growth that resulted from lack of proper tongue and ramal activity.

An anterior open bite, crowding of upper laterals and canines, and a deviated mandible.

As we have already noted, because of the severity of the facial insufficiency caused by the differential bimaxillary retrusions, the hyperdivergence comprising a combination of, insufficient posterior vertical height and excessive anterior vertical height, and some relatively severe airway obstructions we decided to begin treatment with an otolaryngological procedure and to start orthodontic therapy after that was completed.

From the frontal film's image, which differed greatly from the panoramic picture, we suspected the presence of nasal blockage, a finding that needs to be confirmed by an ENT examination and, sometimes, by additional radiographs. In this case, the otolaryngologist operated 9 months after the orthodontic assessment.

Figure 19 b

Frontal cephalogram 2 taken 6 months of orthodontic therapy consisting lingual envelope alone.

1/The ENT intervention, in June 2005, consisted of electrocoagulation of portions of both inferior turbinates, adenoidectomy, and tonsillectomy;

2/The lingual envelope, with no clasps, which was placed in October 2005 and worn for six months, closed the anterior open bite and reduced the mandibular deviation.

Note that despite the removal of obstructive portions of the inferior turbinates, another obstruction persisted, in the left nasal fossa. In spite of cessation of the descent of the symphasis of the mandible as shown by the superimposition of profile cephalograms 1 and 2, and the bimaxillary advancement that carried the anterior bloc with it, obviating the need for orthopedic advancement with a Delaire mask, the radiographic image of left nasal fossa blockage was still cause for concern.

Figure 19 c

Frontal cephalogram 3 taken at time of use of lingual envelope and lip-bumpers.

In a re-examination in October 2006, the otolaryngologist found:

- *persistent hypertrophy of the posterior halves of the inferior turbinates that vasoconstrictors were unable to retract effectively;*
- *chronic bilateral maxillary sinusitis.*

Patient was treated medically with aerosols, antihistamines, and cortisone nasal spray. After scanning X-ray examination it was decided to discontinue ENT treatment and avoid surgical intervention unless the proposed orthodontic therapy failed to meet its objectives.

Note on the frontal cephalogram of 06/02/2008 we noted a persistence of the left nasal fossa blockage, but we could not confirm this in the panoramic film taken at the same time.

Figure 19 d

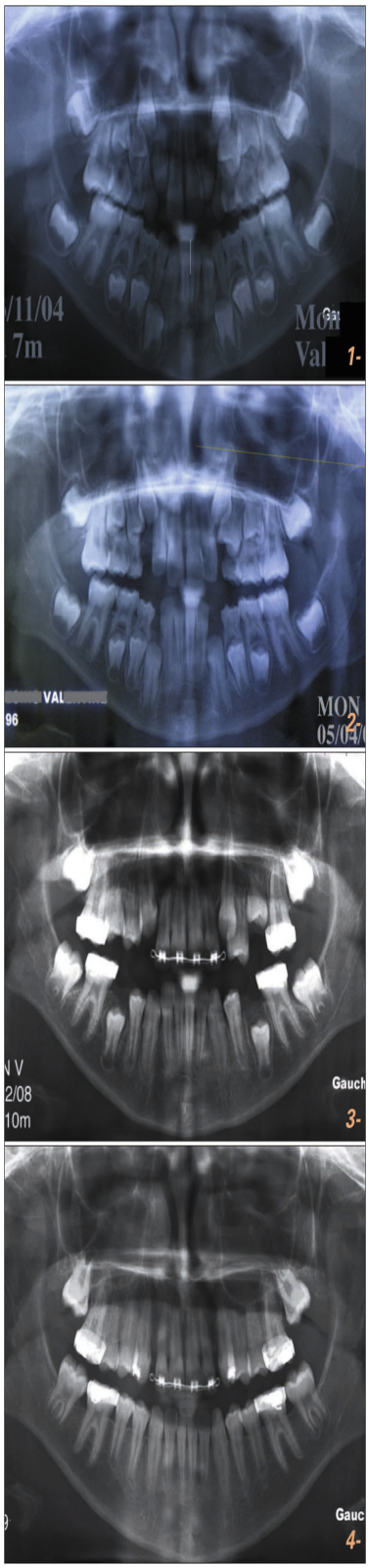
Frontal cephalogram 4 taken at time of lingual envelope and lip-bumper treatment.

The red arrows show the distances between right and left upper and lower molars, as measured on film 4 and copied to films 1, 2, and 3. On film 1 we can measure:

1/the contraction of the lower arch that the more vertical tongue position and the lingual envelope stimulated with the aid of the lip-bumpers even though we had not adjusted the mandibular lip-bumper for contraction;

2/the expansion of the upper arch that the more vertical tongue position and the lingual envelope stimulated with the aid of the lip-bumpers even though we had not adjusted the maxillary lip-bumper for expansion.

The expansion stimulated by occlusal and cortical forces is generated by the increase in the power of occlusion that had, itself, been generated by the vertical transverse ''raising'' of the mandibular buccal teeth into the space liberated by resumption of tongue and ramal growth.



MONT. Val. Panoramic films (fig. 19 e to h)

Figure 19 e Panoramic film 1: orthodontic assessment

Note the state of root formation of the lower posterior teeth. Usually Tongue ramal occlusal cortical treatment, in providing continuous therapy without supervision in the first stage targets to the unstable mixed dentition stage in order to begin to operate.

Here the severity of the hyperdivergence with its excessive anterior vertical growth that risks making lip seal competence completely impossible and thus complicate possible orthognathic surgery forced us to begin orthodontic therapy at an age earlier than would otherwise have been ideal.

But to restrict this therapy to a single stage despite its having begun somewhat precociously we had to extract the temporary molars, await root formation of anterior and bicuspid teeth, and add lip-bumpers to the appliance system.

Figure 19 f Panoramic film taken 6 months after the lingual envelope had been worn as a sole appliance.

As seen on the plate above:

1/The ENT procedure of June 2005 had been removal by electrocoagulation of portions of both inferior turbinate bones, an adenoidectomy, and a tonsillectomy;

2/The lingual envelope, without clasps, was placed in October 2005 and worn for 6 months;

3/All temporary canine teeth were extracted.

In spite of the greatly improved clinical situation, panoramic film 2 showed a disturbing lack of space for eruption of the upper left canine tooth. The erupting upper premolars were rotated, an almost universal finding in cases of severe facial insufficiency with a brachymaxilla that followed an infolding of the dental lamina due to lack of space. On this panoramic film the image of the left nasal fossa seems open and the right blocked, a different picture than the one given by the frontal cephalogram taken at the same time. Concerned by the lack of space for eruption of the maxillary right canine, we sent the patient back to the otolaryngologist for another consultation.

Figure 19 g Panoramic film taken at the time of treatment with lingual envelope, lip bumpers, and a Delaire mask.

We placed the upper and lower lip bumpers 15/11/2007 and had all second temporary molars extracted.

The initial lack of space for eruption of the upper canines is no longer a problem. The removal of the second temporary molars combined with the lip-bumpers' holding the four first permanent molars in place had provided sufficient room for correct eruption of all the canine teeth and accelerated the change into an adult dentition. This made it possible for us to complete treatment before the onset of adolescence despite our having begun treatment ''too soon.'') Note the radiodensity of the maxillary sinuses indicating possible inflammation.

Figure 19 h Panoramic film 4 taken at time of lingual envelope and lip-bumper, but not Delaire mask, therapy.

Now excessive spaces have been developed for upper canine eruption and we shall have to use a full-banded bonded appliance to close them.

Note the radiodensity of the maxillary sinus, more marked on the right, suggesting continued presence of inflammation.

1/Stimulation of ramal growth has generated insufficient descent of Gonion;

2/The Class III molar relationship is aggravated by the distal crown inclination of the upper first molars that action of the lip-bumper has caused. This indicates that the occlusal force needed to prevent this tipping has not yet been developed;

3/Because of the low tongue posture and the probability of predominant mouth breathing we sent the patient for another ENT consultation.

But this patient had a forcible cheek sucking habit that made the lip bumpers painful to wear so she removed them too frequently, complained that they were too long, and finally ''lost'' them, for a second time. We should never overlook, or minimize, the behavioral component in ENT complications that may include more than just poor tongue posture, mouth breathing, or types of incorrect ventilation. Still in this girl's case, without the initial ENT procedure, treatment of her facial insufficiency would have been impossible.

MONT. Val. Facial photographs (fig. 20 a to d)

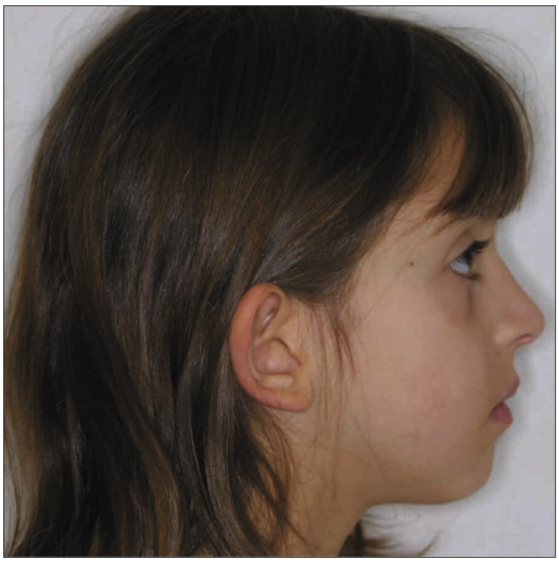


Figure 20 a
Profile photo 1: initial assessment.
Flat forehead, concave paranasal area, short upper lip with indistinct borders, drooping labial commissure, crispation of menton area, and shortness of sub-menton area.

Figure 20 b
Profile photo 2: in treatment.
Bimaxillary advancement has begun and with it the vertical portion of the forehead, the paranasal region, the upper and lower lip and menton. The sub-mental region has elongated and the skin around menton is re-shaped. The commissure has risen.

Figure 20 c
Full-face photo 1: initial assessment.
Paranasal regions retreating, inter-commissure line concave because of commissure drooping, upper lip short, crispation of menton when patient was asked to keep her lips closed.

Figure 20 d
Full-face photo 1: in treatment.
Paranasal regions have moved forward and the lip commissures have risen.

MONT. Val. Facial photographs (fig. 20 e to h)

Figure 20 e
Profile photo 3: in treatment.
Bimaxillary advancement continues and the forehead moves forward as well in what might be called a facial transfrontalization. Note the transformation of the lips: the commissure has risen, the lip border is accentuated, and, overall, the lips are plumper.

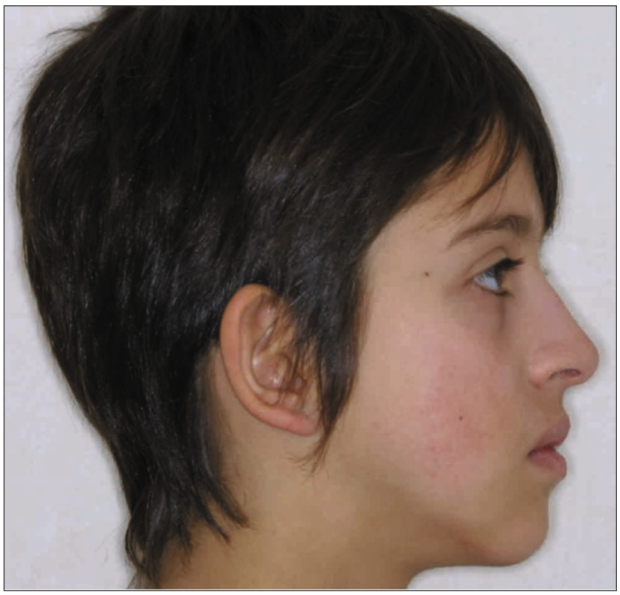


Figure 20 f
Profile photo 4: in treatment.
The facial frontalization continues, giving her a more ''square-jawed appearance.'' The lip changes continue as well. Note the contrast in photo 1 and 4 in the raising of the commissure, the accentuation of the labial border, and the lip plumpness. The skin around menton is harmonious and the base of the nose is better delineated.

Figure 20 g
Full-face photo 3: in treatment.
Advancement of paranasal regions continues, as does the raising of the lip commissures.

Figure 20 h
Full-face photo 4: in treatment.
Advancement of paranasal regions continues, as does the raising of the lip commissures. Lip closure still needs to be observed carefully.

6 – CONCLUSION

We are thoroughly convinced of the vital importance of orthodontic and ENT specialists cooperating closely with each other. We, as orthodontists have fundamental roles to play, first in convincing otolaryngologists of the benefits of our collaboration, and, second, in establishing orthodontic therapy that will effectively reduce facial insufficiency, a veritable technique of ''medically assisted growth.'' In its first stage this method modifies tongue behavior. In the second stage it changes the way and power with which the teeth of one arch occlude with the teeth of the other. Thanks to this therapy, the blockage exerted by the mandible on the maxilla is lifted, and vertical restraints on maxillary advancement are removed.

An appraisal of the three cases we have presented in this article, especially of the improvement in their upper airways stemming from the orthopedic process basically functional in nature, should encourage readers to share our conviction that ''orthodontic treatment can increase the volume of the nasal and oropharyngeal passageways in conjunction with maintaining good nasal ventilation'' and to understand the benefits of intimate collaboration between orthodontic and ENT specialists.

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