

## EDGEWISE TODAY...

THE 2008 L. LEVERN MERRIFIELD LECTURE (VARESE, ITALY)  
André J. Horn

It is an honor to give this Merrifield Memorial Lecture at the 27th Biennial Meeting in Varese Italy. The very first Memorial Lecture was given by Lennart Weislander in Paris in 1996. Since then, we have had famous lecturers: Vincent Kokich, Bjorn Zachrisson, Lysle Johnston, Don Joondeph and Robert Isaacson...So I ask, WHY ME?

In a 1982 lecture in Tucson, I quoted the French philosopher Andre Malraux: "If we want to be better and better in our own professional life, we must transform our experiences into knowledge". Has it happened yet? Is there enough evidence in orthodontics on which to base the diagnosis, the treatment plan and the treatment in order to make the best decision for the patient?

Today we are going to think about our speciality of orthodontics. Despite impressive technical advances over the past twenty years, the speciality, as well as the education of people entering orthodontics, is changing. Tragically, many think we may not have orthodontics as a specialty for much longer. Every practitioner seems to want to use "magic" and automatic systems to align teeth. I wonder if the next decade's "scientific" meetings and university courses will be organized by manufacturers of orthodontic appliances. During the last 30 years, I thought I was working in a medical field! Today our patients, the media and the supply companies

would like to reduce our responsibilities to a cosmetic activity! But, the success of orthodontics as a science does not depend only on alignment of six anterior teeth. We don't sell esthetic appliances or automatic aligners.

Every individual dentition is built to an exact functional and esthetic finished occlusion with no margin of error or compromise. Such attention to detail is something that has become second nature to us, as natural in fact as the technology we use: the standard edgewise with the zero slot brackets. Our appliances are constructed individually in the same tried and tested way as a generation of orthodontists did before us.

### **Where are we today, and where are we going?**

In 1975 I was selected by Roger O'Meyer to take my first Tweed course. At this time it was the beginning of a long life in the Tweed family. I took the course again in 1977; Charles Taylor was my sponsor. Since 1978, I have been an instructor for the Tweed Study course in Tucson.

I was elected as President of the Foundation for the 1994 - 1996 term and organized the 1996 Paris Biennial meeting. L.L. Merrifield changed my life and will be my mentor forever. Jack Dale was the example I decided to "follow", as he was one of the first in orthodontists to encourage mixed dentition management.



I do not place a lot of importance on controversies. In orthodontics we have had the non-extraction versus extraction debate which continues to this day. We also have the one stage versus two stage treatment debate. As Plato said *“We must face the fact that a lot of things we don't believe in are true. And conversely, a lot of things that we believe in are not true.”*

For this Merrifield Memorial Lecture I want to give an overview of diagnosis and treatment planning that encourages a strategy for class II correction and a beautiful face. At the conclusion of the lecture I will discuss stability.

A patient's strongest motivation for self improvement is appearance. The “beautiful face” includes straight teeth. Physical attractiveness tends to be associated with health preserving behavior. Dental esthetics contributes to psychological well being of children and adults. From the patient's perspective, esthetics is of primary concern. Functional improvement and dental health considerations are strictly secondary. Orthodontists must evaluate a patient's esthetic concerns very carefully when planning treatment, even though the clinician's major consideration is to establish an improved long term dental health condition.

Our expertise is primarily based upon diagnosis, treatment planning and treatment control. The major problem in orthodontics is not to move teeth, but to put them in harmony with the face and in correct function so that stability after treatment is insured.

Diagnostic and treatment decisions should be based on: **Faces First!** The skeletal pattern and the teeth must then be considered. Evaluation of the smile will immediately show where the pathology is located and will give clues about the anchorage required to upright mandibular and maxillary anterior teeth. The correction of a gummy smile by vertical repositioning of the maxillary incisors necessitates diagnosis and treatment planning before appliance placement.

An esthetic analysis must evaluate the profile line and its relationship to the nose, the upper and lower lips and

the chin. Merrifield's Z-line (the profile line) intercepts the nose in low angle patients and is in front of the nose in high angle patients.

A “closed” facial type patient (deep-bite face, low angle) is going to age faster if there is a decrease in the vertical dimension of the lower one third of the face. Extractions can emphasize this decrease and accelerate aging of the soft tissues. Extractions are often contraindicated for this type of patient. But an “open bite” face (high angle) will “accept” extractions. The goal for the high angle patient is to decrease the vertical height and protrusion and effect a relaxing and repositioning of the soft tissues.

When facial esthetics is considered, the upper face determines strategy. For facial balance, the maxillary incisor should be the reference, not the mandibular. The position of the mandibular incisor is the result of compensation to the sagittal and vertical disharmony, but also to the function of soft tissues, speaking, swallowing, and mastication.

For class II treatment planning, it is important to plan for the posttreatment position of the maxillary incisor. This statement implies that the skeletal class II relationship cannot be corrected with only mandibular incisor compensation. Tweed's diagnostic facial triangle established guidelines for the theoretical uprighting of the mandibular incisor. Total space analysis precisely quantifies the mandibular arch deficit in the area in which this deficit exists. But, only occlusions and dental casts are being considered. The faces to whom these occlusions belong are not in the picture.

Angle's definition of the Class II relationship is subject to debate. The class II molar relationship is best described as a distal relation of the mandibular first molar to the maxillary molar. The maxillary molar is a reference because it has been never demonstrated that its distal movement is stable. In general the maxillary structures are identical whatever the Angle's classification. The mandibular incisor adapts itself to its environment: skeletal and muscular. Its position depends on the environment. So, most of the time the maxillary incisor



could be the guideline for decisions about the face. The mandibular incisor compensates for the dysfunction.

Prior to any diagnosis based on mandibular incisor position, the effects of habits and neuro-muscular pathologies must be eliminated. If the diagnosis is based on the mandibular incisor position, this reference must be very reliable.

Most of the time, in class II patients, the Dreyfus plane is tangent to the labial surface of the maxillary incisor. This means that the maxillary incisor is in a good location. It is time to realize that in many dental Class IIs, the maxillary molars are well positioned in the maxilla and the maxillary incisors are often well positioned in the smile. The treatment should be one of mandibular growth management and management of sagittal, transverse and vertical dimensions of the lower face.

#### THE CRANIOFACIAL ANALYSIS

This analysis makes the clinician much more aware of the difficulty of treatment for patients who are outside the normal range of skeletal values. In order to understand the degree of difficulty of a particular malocclusion correction, the most significant cephalometric measurements have been selected and weighted to be used as a **clinical alarm signal**.

The higher the difficulty index, the lower the prognosis for success. We have used the cranial facial analysis and have compared the difficulty of orthodontic treatment to facial improvement in an attempt to quantify our orthodontic results. This comparison gives the young clinician certain insights and warning signals about particular types of malocclusions.

There are three components of the craniofacial analysis:

1. Vertical discrepancy: FMA, FHI, Occlusal Plane
2. Horizontal discrepancy: ANB, SNB
3. Facial discrepancy: Z-Angle.

Vertical discrepancy differentiates the “extraction faces” of high angle patients from the “non-extraction faces” of low angle patients. Treatment of these patients necessitates either the contraction or expansion of the soft tissues. The horizontal discrepancy determines which teeth to extract in the maxilla in order to correct the protrusion. The extraction choice is different for patients with a maxillary protrusion (a large SNA resulting in a large ANB), than for the patient with mandibular retrusion (a large ANB caused by a small SNB). The use of the Z-angle clarifies the extraction decision. A small Z-angle may be caused by a vertical discrepancy or by a horizontal discrepancy or both. The Z-angle may also be decreased by a large FMIA. A Z-angle that is low because of this problem takes the clinician back to the original significance of the FMIA as it was described by Dr. Tweed. The question then becomes, **“If extractions are needed to correct the occlusion, which extractions will correct the occlusion and yet protect or improve the face?”** To facilitate more inter-relationship between the craniofacial analysis and the occlusal analysis as decisions are made, some aspects of the total space analysis must be integrated into the craniofacial analysis. In other words, a headfilm correction for two different patients might be the same, but it might not have the same clinical significance because different teeth need to be extracted. The same amount of protrusion might not have the same significance if the Z angle is low as it will if it is high. No matter if the face is straight or protrusive, it becomes the determining factor in the extraction decision, and one must differentiate between: **Absolute deficits and Virtual deficits**.

It is a fact that the space deficit that results from crowding and/or from a deep curve of Spee is absolute. But the relocation of the mandibular incisor might be theoretical because it requires that a tooth be moved to an average position. Clinical experience in treatment planning must determine the difference between the patient for whom the mandibular incisor should be upright and the patient for whom the incisor might not need to be as upright. Even if the headfilm correction is the same for



both patients, the problem is to produce results that are consistent and reproducible.

Treatment strategy depends on occlusal pathology and facial pattern. The same amount of crowding will have a different significance for a low angle patient where slight expansion might improve the face, while for a high angle patient expansion will accentuate the rotation in the horizontal planes, increase the protrusion and increase facial disharmony.

It is known that the general tendencies for growth and aging influence the closing of the horizontal planes and thus decrease the vertical dimension. For high angle patients a good extraction decision and good mechanical control may accelerate these rotational phenomena and the long-term results will be very satisfactory. On the contrary, for the low angle patient, extractions may accelerate the decrease of vertical planes and accelerate aging.

It would be interesting to be able to anticipate mandibular rotation, especially in a normal angle population, and thus be able to decide whether to extract or not to extract in borderline situations. In order to help with the extraction decision, a sample of 240 patients treated with edgewise therapeutics was studied. Three groups were created according to different extraction choices: treatment without extractions, treatment with extraction of the four first premolars and treatment with extraction of the maxillary first premolars and the mandibular second premolars.

#### **BEFORE TREATMENT**

Within this sample of 240 patients were found 140 “normal angle” patients (patients whose FMA was between  $22^{\circ}$  and  $28^{\circ}$  at the beginning of treatment). The Facial Height Index of these 140 patients ranged between .53 and .83. This FHI variation signifies that within this population some patients will tend to “open” and others “close” during treatment. It is of the utmost importance to appreciate this fact before treatment in order to devise the proper treatment plan and have suitable control

of the mechanics. During orthodontic treatment, vertical control is the key to success. It does not take much loss of vertical control to overturn the balance and go from an unstable state to a catastrophic state.

The study of the FHI is evidence of the importance of the vertical dimension in prognosis, treatment planning and in treatment results. For a normal angle patient, and worse for a high angle patient, to level the mandibular arch with “soft” wires without controlling the extrusion of the midarch area is a predisposition to failure. On the other hand, good control of the vertical dimension during treatment will permit favorable rotation and augment a good facial response.

Before treatment, the decision whether to extract the premolars or not depends essentially on the vertical Index: FHI was an average of .75 for 95 patients in the study who were treated without extractions. One hundred and thirty two of the patients were treated with extractions. The average index was .69 and the majority of the patients were normal or high angle patients. Therefore, FHI is one of the decisive factors for determining whether to extract or not to extract mandibular premolars.

#### **AFTER TREATMENT**

In the nonextraction group, the FHI increased from .75 to .77; the “closing tendency” was more pronounced. The profile “flattening” (Z angle changed from  $72^{\circ}$  to  $77^{\circ}$ ) should not to be considered to be a result of extraction! In the group treated with the extraction of the first premolars the FHI increased from .68 to .70. The tendency for “closing” is significant and the profile change is distinct; the Z angle increased from  $66^{\circ}$  to  $74.5^{\circ}$ ! In the group treated by extraction of second premolars the index increased from .72 to .74 and the face changed with a Z angle increase of from  $64^{\circ}$  to  $72^{\circ}$ .

During retention, the horizontal planes continued to close and the index increased no matter what the choice: extraction or non-extraction. A proper treatment plan and non-extrusive mechanics can, in patients with a high angle tendency, give a very satisfac-



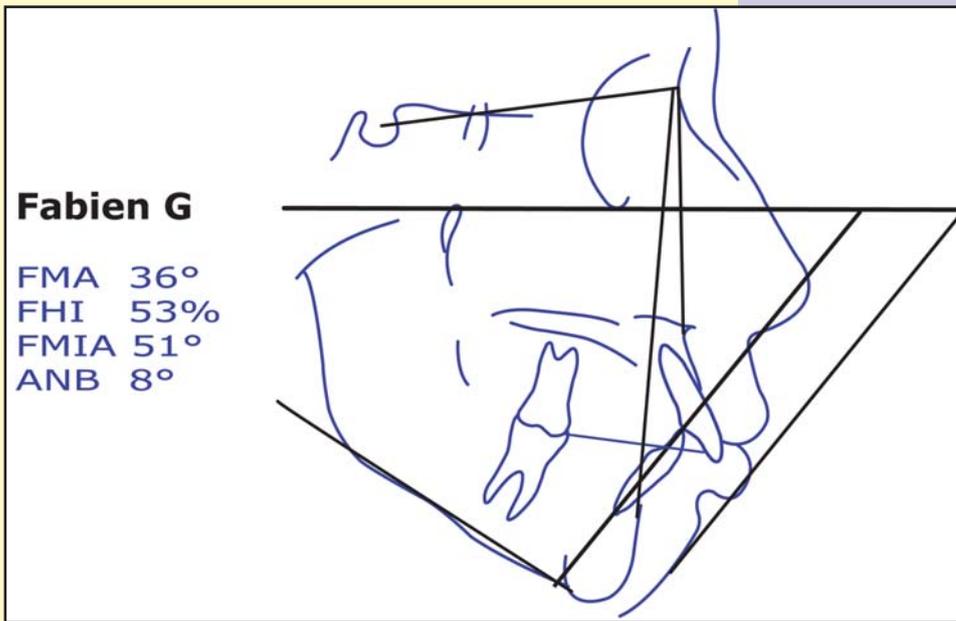


Figure 1

tory facial result. On the other hand, the “mix” of bad therapeutic decisions and uncontrolled mechanics may cause catastrophic results for the normal angle patient who presents a tendency toward opening of the occlusal plane.

For Class II patients who have a mandibular discrepancy, to take advantage of the growth pattern without disturbing the anterior rotation in the mandible necessitates a choice of posterior extractions in the mandible — the second premolars — along with mechanics that will mesialize the mandibular posterior teeth without using a lot of Class II mechanics. Observe this Class II malocclusion tracing (Figure 1). There is a vertical “problem”: FMA is 36° and the Facial Height Index is .53 (the average is .70). These values signify that the ramus length is very small for a face of normal height, even though the palatal plane is high. The occlusal plane to Frankfort angle is slightly high at 14°. The vertical component of the craniofacial difficulty index is 78.

The horizontal component (ANB is 8° and SNB is 77°) is out of balance. The horizontal difficulty index is 80. One must try to increase the SNB with an anterior rotation of the mandible, in other words, enhance mandibular response.

The Z angle (50°) is low because of the dental protrusion and because of lip thickness. By correcting the protrusion and uprighting the mandibular incisors, the patient can have a distinct profile improvement. What should be done with an FMIA value of 51°? A most outstanding “tool” left to us by Dr. Tweed was his formula for the position of the mandibular incisor. One measure of a clinician’s ability lies in an appreciation of mandibular incisor compensation: is it pathological or is it acceptable? For this patient what are the criteria?

The same discourse can be made with the curve of Spee and the Class II correction. It is certain that for some high angles patient like this one the FMIA angle is more directly related to FMA than to the IMPA of 93°. Repositioning of mandibular incisors is needed due to the vertical problem even though IMPA alone does not seem so far from “normal”.

Only the mid and lower areas of the face reflect facial harmony; both depend on growth tendencies and treatment. The mid area of the face depends on the maxilla; the position of the maxillary incisors, the upper lip and the nose. The lower facial area depends on the mandible and the position of the mandibular incisors, the lower lip and the chin.

For this Class II patient the maxilla does not have an excessive protrusion. The maxillary incisor is well balanced in the profile but there is a mandibular discrepancy. The goal is to augment mandibular rotation while controlling the occlusal plane.

Any modification of the anterior occlusion will have an effect on the esthetic and functional balance of the soft

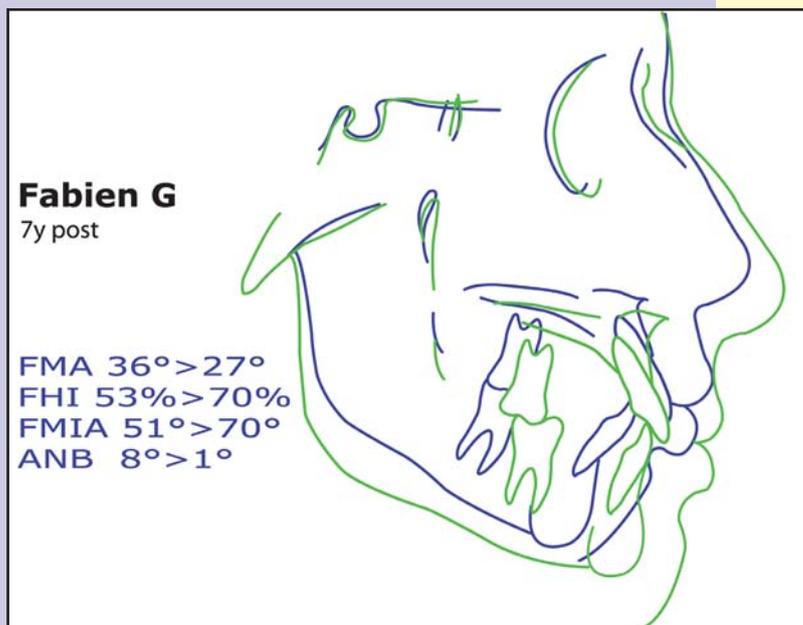


Figure 2

tissues. Before making any treatment decisions, it is important to anticipate the effects each will have on facial balance. Growth and development in the nose and chin areas do not depend on orthodontic treatment, but they may influence facial harmony and may cause more reaction than a unique volumetric development.

In a Class II patient with bialveolar protrusion, the occlusal treatment goals are to increase the FMIA, decrease the ANB, and close the FMA. Realizing these goals will re-establish facial harmony because all these orthodontic actions will stimulate a Z angle increase. For these types of patients the extraction of the maxillary first premolars and the mandibular second premolars is a good choice. It will permit a corono-lingual repositioning of the mandibular incisors by closing the horizontal planes without Class II mechanics. While analyzing the modifications in the soft tissue of patients in the sample, it was noted that the contraction of the alveolar dental mass (extractions) induced a better distribution of the soft tissues.

What can be said about the long-term evolution of the profile? During normal growth, faces have the tenden-

cy to “close”. To integrate this closing tendency during orthodontic treatment of normal or high angle patients is to take the option of facial improvement and to obtain a long-term “mandibular response”.

In studying this superimposition (Figure 2), it can be seen that the “mandibular response” is linked to the correction of the protrusion and the closing of the mandibular plane. Seven years post treatment the maxillary incisors have the same position on the Dreyffus plane. Note the huge mandibular response — both horizontal and vertical. FMA closed from  $36^\circ$  to  $27^\circ$ ; ANB was reduced from  $8^\circ$  to  $1^\circ$ .

Conversely, a much too drastic correction of the anterior protrusion in a “closed” facial profile may result in poor long-term facial esthetics and aging of the face may be accelerated. The profile line and the Dreyffus and Simon configurations help with decision making and the means of control is interesting:

For girls with normal faces, one must try to position the profile line in the middle of the “S” made by the ala of the nose. For boys, on the other hand, the profile line should touch just the tip of the nose because chin and nose growth are more active over time.

For high angle patients the profile line should lie in the middle of the nose. In low angle patients the profile line often cuts through the nose at the beginning of treatment so the clinician must try to maintain its position towards the tip of the nose as much as possible.

#### THE TWO PHASE TREATMENT PROTOCOL:

- the first phase is a functional and orthopedic therapy
- the second phase is nonextraction Tweed mechanics before second molars erupt.

Most European class II patients have a short mandible, or a normal mandible in a backward position. This



Figure 3

young mixed dentition patient (Figure 3) exhibits a full step class II and a large anterior overjet. The maxillary incisor is where it should be. Pogonion is retruded relative to the Dreyfus plane. The upper face is “Class 1”. The lower face is “Class II”. An orthopedic functional appliance might, in some instances, accelerate mandibular growth. This patient illustrates the concept.

At the end of phase 1, observe the relative “forward position” of the chin. The upper and lower jaws are now well balanced. The occlusion at the end of phase I shows a class I molar relationship. After phase II treatment with Tweed-Merrifield mechanics, observe the ideal class I occlusion and a well balanced profile.

The final improvement of the profile is due to a combination of mandibular growth during phase I, and the effects of edgewise class II mechanics with maximum vertical control on the closure of the vertical dimension during phase II.

Our practice is studying many patients treated with the two phase protocol. All patients are treated in a single practice by the same two clinicians. This fact provides more consistent and reproducible results. In our office, we have studied both populations — one treated with one phase, the other with a two phase protocol. The patients in the first group wore class II elastics at least 12 months. The second group, the two phase group, wore

them only 6 months. So, when you correct a part of the class II early, the second phase with edgewise fixed appliances was found to be “less severe” and less class II elastic wear was required.

Our experience shows that in class II patients, the fewer extractions we do in low or normodivergent patients, the better the facial response. We treat 75% of these low angle patients without extraction. Of this 75%, 10% have early mixed dentition treatment. Most patients who

need premolar extraction are hyperdivergent. Normally, maxillary first and mandibular second premolars are the teeth that are extracted when extractions are done.

#### BACK TO FUNDAMENTALS!

There is no automatic system that provides an ideal and esthetic occlusion. The secret of orthodontics doesn’t lie in commercial catalogues. Orthodontics is not alignment only. “Aligners” are not the future for orthodontic treatment! Orthodontics is diagnosis, treatment planning for an individual patient and individual archwires. We use the **zero slot bracket** designed by Dr. Angle. The force comes from the archwire, bent individually for each step of treatment. The force is placed into the archwires in order to properly align the teeth and to accomplish maximum interdigitation in order to achieve a functional, esthetic and stable occlusion. It is a pure individual technical concept because each patient is an individual.

The individual bends require understanding that each patient is unique and most often requires an individualized approach during treatment - from leveling to finishing. The Tweed Merrifield system is the best available to control dental compensation in the different situations: Class I, Class II and Class III.

Our treatment strategy is:

- Level the mandibular arch for most class II patients
- Prepare anchorage with rectangular archwires
- Level the maxillary arch with class II elastics
- Space closure and anterior torque control: closing loops and individual root torque
- Finish with class II mechanics

#### STABILITY

A primary objective in orthodontics must be occlusal stability. This means the repositioning of teeth and the management of the dentition in harmony with the craniofacial and muscular morphology — without retainers for life! The secret to stability is over treatment. This can't be done with an “aligner”. Occlusal management depends on the position of the mandibular incisor and its dentoalveolar, periodontal, neuromuscular and esthetic balance. Profile harmony depends essentially on the vertical plane. It is the relationship between occlusion and facial harmony that will determine long term stability. The factors that seem to influence stability of the dentition are: growth, treatment plan, extraction location, mechanics and patient cooperation.

The only question that is asked these days in dental journals is “to extract” or “not to extract”. But no one can prove that the secret of stability is extraction. Little demonstrated that 70% of patients relapse no matter what the therapeutic choice. Boley demonstrated that he had very few relapses after extractions. Cetlin and Ten Hoeve declared the opposite. The key to treatment stability does not reside in the fact of extraction or non-extraction but in the actual extraction choice — which teeth to extract if we must extract. If we consider that extractions are well accepted in some patients, why not in others?

I agree with Dr Cannon when he said that “we all know that the dentition continues to move during the patient's life and that tooth alignment does not improve with age. But, as orthodontists, we believe that orthodontic treatment will improve the happiness and well being of our

patients and, with this in mind, we enjoy treating them in an atmosphere of trust and friendship. So we are disillusioned when we are confronted with relapses and we realize that many objectives we had anticipated are not achieved for some of our patients in the long-term.”

Remember what Duncan and Noffel often said: “The orthodontist has the unique ability to alter faces or to achieve the very best face for each patient. It is just as easy to make faces worse as it is to make them better”.

The clinical evaluation of the occlusion and long-term facial results is derived from a complex and multifactorial approach. Some factors are quantifiable and numerous authors have seriously studied them with conviction only to arrive at contradictory results. In effect, it is important to realize that a large number of the determining factors in a treatment plan are factors that can be put under the heading of clinician's intuition. It is thus more important to trust your instincts than to abide to some “rigid” concepts that could be false.

#### TWEED is still NOW.

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## “EARLY TREATMENT” PLANNING: A TWO-PHASE PROTOCOL FOR CLASS II HYPODIVERGENT PATIENTS

Isabelle Jegou

Class II correction has been a subject of debate in orthodontics for many years. Many claim the efficacy of their respective position on the subject of how to transform a Class II molar relationship into a Class I molar relationship. Some orthodontists, most of whom practiced in northern Europe during the early years of our specialty, desired to correct a Class II dental relationship as early as possible with functional appliances. Because these people did not bend wire, they were, in some instances, regarded as poor orthodontists. Since that time, however, functional appliances are accepted and many are used throughout the world.

In the same era another group of practitioners, most of whom lived in America and practiced under the influence of Edward Angle, preferred to wait until full eruption of the dentition before starting treatment with the edgewise appliance. In order to correct a Class II molar relationship these people used intraoral and extraoral forces to distalize the maxillary arch. This was done because at this time Dr. Angle defined a Class II relationship as the mesial position of the maxillary molar in relation to the mandibular molar, not the distal relationship of the mandibular molar to the maxillary molar.

Since the infancy of the specialty, controversy has been a part of our daily life. Controversy existed between the “mechanics” people and the “functional” people with neither side believing that the other had anything to offer. While this controversy was going on between these schools of thought, the extraction/non-extraction

controversy got started. Orthodontics still debates these issues.

As we look at the function vs. mechanics controversy, it could probably be said that both “camps” can claim a bit of the truth. It is important that a day-to-day protocol for Class II correction which uses a facial analysis along with occlusal management be considered. Facial growth is a composite of matrix and intramatrix rotations. It is evident that intramatrix rotations can be influenced by orthopedic as well as orthodontic therapies as Rowe and Carlson demonstrated (Figure 1). This idea gives a new dimension to functional

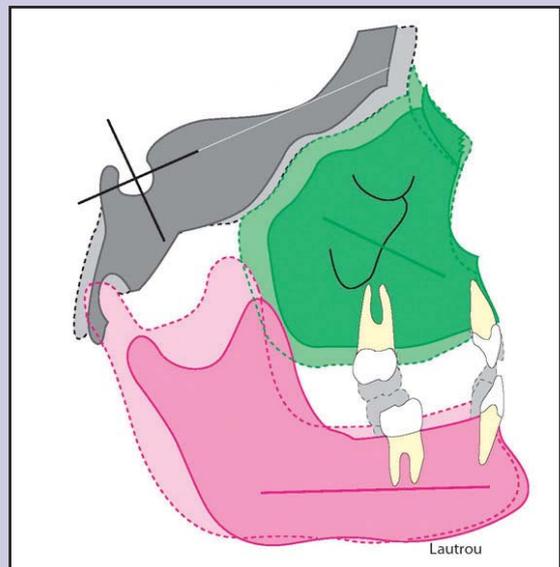


Figure 1: On this superimposition of the Dibtets protocol from A Lautrou note the growth rotational tendencies of the mandible and the maxilla in relation to the stable cranial base.

therapy for the hypodivergent Class II malocclusion. It is a fact that mandibular growth continues longer than maxillary growth. The natural tendency, therefore, is for a mandibular molar to move forward into a Class I relationship if it is unimpeded. Functional appliances are designed to remove all the “blocking forces” of a Class II occlusion, keep the maxillary molar in place and allow mandibular growth to express itself in order to ensure Class II dental correction. A two phase protocol is essential if this approach is used.

#### DIAGNOSIS AND ANALYSIS

During the diagnosis, the primary concern of the clinician should be **FACES FIRST!!** After the face is considered the skeletal pattern is studied and last, but not least, the teeth.

#### I. THE FACE

For Class II correction, a facial analysis is absolutely essential and very important. A facial analysis should be based on a static and dynamic profile analysis as well as a smile analysis.

**Profile Analysis:** Dr. Merrifield’s facial analysis is composed of the profile line (a line which is tangent to the chin and the most protrusive lip) and the Z angle (the inferior angle formed by Frankfort and the profile line). On a well balanced face the profile line bisects the nose at the anterior portion of the ala. The ideal Z angle value is  $74^\circ$ . When the Z angle is smaller, the face is unbalanced and the profile is convex. Guidelines indicate extractions are normally necessary in order to upright the mandibular incisors and reduce the profile protrusion. When the Z angle is large, however, the profile is straight or even concave. Normally, extractions are contraindicated for this type of face.

Dr. Noffel added a qualitative description of the profile line and its relationship to the nose:

When the profile line is outside the nose and the patient has a low facial height index, extraction of premolars is probably indicated.

When the profile line is close to the nose, or if it bisects the nose, and the patient has a high facial index, the extraction of the teeth will accelerate aging by a contraction of the face. The facial situation becomes more critical if the patient has a Class II malocclusion. So, even if there is a dental deficit, mandibular premolar extractions are normally contraindicated for low mandibular plane angle patients.

The sagittal location of the chin influences the validity of the Z angle. When the Z angle is small, the profile line lies outside the nose. Extraction might be the best way to increase the Z angle. But if the mandible is retrognathic, forward movement of the mandible would be more appropriate. For the Class II face, a sagittal reference to evaluate the position of the chin is needed.

Drs. Horn and Jegu use the A M Schwarz qualitative analysis of front and profile photos of the patient which can help the clinician with the Class II facial decision. This qualitative analysis is done in the following manner: Draw the Dreyfus plane perpendicular to Frankfort and pass it through the nasal base on the pretreatment patient profile photograph. Draw Simon’s orbital plane perpendicular to Frankfort and pass it through the pupil of the eye (Figure 2). This “drawing” underscores the significance of the lips and the chin in facial harmony. The space between these two planes, called the **mandibular space**, should give the clinician a qualita-

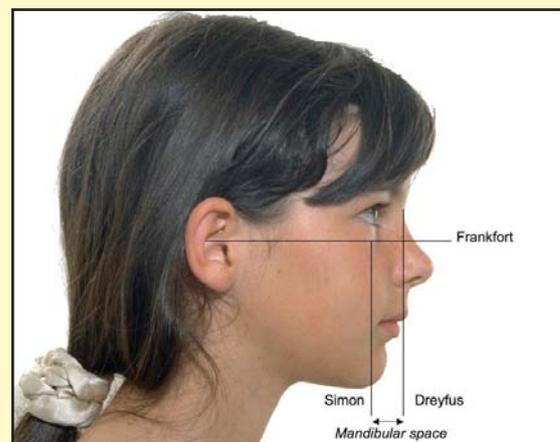


Figure 2: the Mandibular space

tive prognosis for Class II faces. If the chin is located inside the mandibular space, the Z angle and the profile line are valid. The prognosis is favorable; the Class II guidelines should be followed. If the chin is located to the rear of the mandibular space, the Z angle and the profile line are not valid (Figure 3a, 3b, 3c).

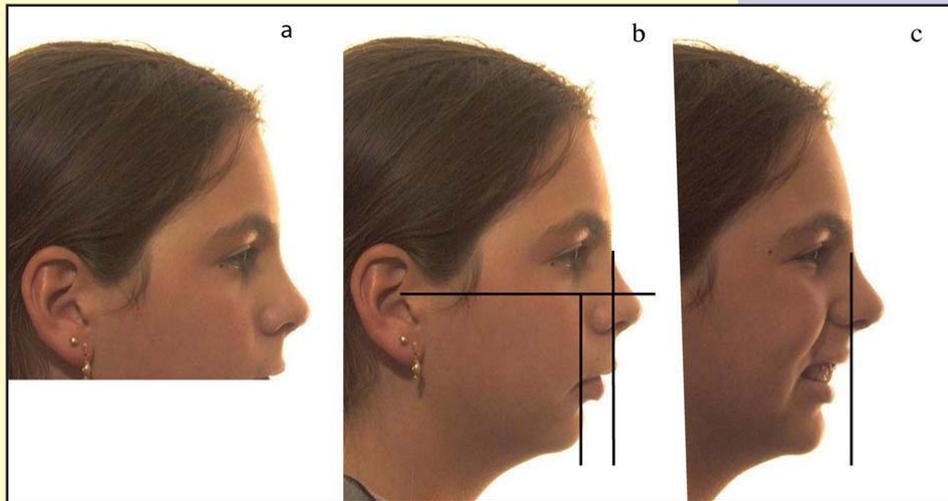


Figure 3a: on this pretreatment profile photograph, hide the lower face with a piece of paper, and evaluate the harmony between the nose and upper lip. There is nice harmony in the upper face.

Figure 3b: Secondly, move the paper away and visualize the position of the chin related to the upper face. The Dreyfus plane points out a retrognathic mandible and a well balance maxilla.

Figure 3c: When this patient smiles, the stretching of the upper lip accentuates the retrusive position of the maxillary incisors. In this patient it is unthinkable to correct the class II malocclusion by retracting the maxilla.



Figures 4a and 4b

## A. SMILE EVALUATION

The front smile photograph should immediately give the clinician objectives for tooth movement. For Class II Division 2 patients the front smile might be gummy (Figure 4a). The proper force direction for these patients will be an intrusive movement of the maxillary incisors during leveling and denture correction. However, many times the smile for hypodivergent patients is poor. Sometimes no tooth mass shows, even if an overbite is present. These patients need extrusive forces without any high pull headgear force to the anterior part of the maxillary arch.

If the profile smile is well balanced, the Dreyfus plane is tangent to or parallel to the labial surface of the maxillary central incisor. On the profile smile of this hypodivergent patient (Figure 4b) teeth are well placed in the vertical plane and the labial surface of the maxillary incisors is parallel to the Dreyfus plane. Maxillary tooth position is ideal. The problem now becomes: How does one correct the Class II malocclusion without retraction of the maxillary teeth? I suggest that the clinician needs to treat these difficult Class II faces differently.

## II. SKELETAL PATTERN

For hyperdivergent patients the objective of treatment is to decrease anterior facial height by using a correct treatment plan and favorable directional forces. Extractions are used and the guidelines indicate which teeth should be extracted in order to correct the occlusion and improve facial balance and harmony. The goal

is to close the horizontal planes and therefore, improve the face. Class II mechanics without anchorage preparation must be avoided. Maxillary first and mandibular second premolar extraction is usually quite appropriate for Class II hyperdivergent malocclusions.

For the hypodivergent malocclusion, an objective is to increase anterior facial height. Alveolar expansion is indicated in the vertical and transverse dimension. Premolar extractions are generally contraindicated. Mandibular tip back bends and Class II mechanics can enhance vertical expansion which can improve the face.

### III. DENTAL

The total space analysis described by Merrifield evaluates dental deficits and the anterior, midarch and posterior areas of the dentition. Incisor alignment, crowding reduction, curve of Spee leveling and Class II correction have to be considered differently when the vertical dimension is considered. In hyperdivergent patients the midarch deficit is of utmost importance when it is related to the anterior deficit. Because of an unfavorable growth direction, mild Class II malocclusions have to be treated with maxillary first and mandibular second premolar extractions. The mandibular extraction space must be managed so that crowded mandibular anterior teeth are aligned and the mandibular first molars moved forward. The mandibular incisors should be maintained in their pretreatment labiolingual position. Class II elastics are used to help with final intercuspation. Mechanics are specifically adjusted to mesialize the mandibular first molars. The second molars often erupt in reasonably good alignment.

In hypodivergent patients crowding can be related to the vertical contraction of the face. If crowding exists, the only alternative to no extractions is expansion. If the total space analysis shows a space deficit, it is, in my opinion, a theoretical deficit. Because vertical and transverse expansion increase lower face height, the lower arch can be attempted nonextraction. A compromise in mandibular incisor position is acceptable. The posterior deficit is absolute and must be evaluated on

the pretreatment records. For these patients the mandibular third molars must be extracted to facilitate leveling the curve Spee.

### DENTAL AGE AND MECHANICAL CONSIDERATIONS

The total space analysis diagnoses the space required in the dentition. Using Tweed/Merrifield mechanics, one would like to start treatment with the full compliment of teeth in order to prepare anchorage in the mandibular posterior segment. Treatment steps are controlled by directional forces: leveling, canine retraction, space closure, anchorage preparation and Class II mechanics. This concept of Class II treatment distalizes the maxillary teeth while mandibular growth takes place. This treatment protocol requires strong motivation from the patient when using the Class II force system.

If the clinician desires to get mandibular change with a nonextraction concept, the malocclusion can be started earlier. For this reason, we start treatment a little earlier for the Class II hypodivergent or normodivergent patient who has a non-premolar extraction treatment plan.

### TWO PHASE PROTOCOL

The objective of the first phase of treatment is to correct the skeletal, dental, alveolar and muscular imbalances in order to improve the orofacial environment for the eruption of the permanent dentition. This management plan requires the use of functional or orthopedic forces in young patients who are in the late mixed dentition. This phase of treatment is immediately followed by fixed appliance therapy with nonextraction Tweed/Merrifield force systems prior to second molar eruption. With this protocol, we seem to have less extractions and less surgical treatment.

### CASE REPORTS

Alexis B. is 10 ½ years old at his first visit. He presents with a dental Class II malocclusion and a hypodivergent skeletal pattern. The pretreatment facial photographs (Figure 5) show a convex facial profile, a low angle face, lip protrusion and a retrognathic chin. His

smile is well balanced in the vertical dimension. The pretreatment cephalometric tracing (Figure 6) confirms the retrusion of both the maxilla and the mandible (SNA is  $76^\circ$ , SNB is  $72^\circ$ ). The vertical values confirm a hypodivergent skeletal pattern with an FMA of  $20^\circ$  and FHI of .79. The Z angle of  $48^\circ$  confirms an unbalanced face due to maxillary incisor protrusion and the retrognathic chin. When studying the Dreyfus plane, the chin is located to the rear of the mandibular space. The mandibular incisors present labial inclination with an IMPA of  $100^\circ$  and an FMIA of  $60^\circ$ . When the chin is so retrusive, the Z angle and the profile line are not “valid”. Incisor uprighting must be compromised. The maxillary incisor labial surface is tangent to Dreyfus, so a backward and intrusive movement of the maxillary incisors should be avoided. The pretreatment casts (Figure 6) show a Class II dental relationship, a large overbite and an overjet of 10 mm. There is no crowding. The four second deciduous molars are present. The permanent second molars have not erupted. No habits are suspected. The maxillary and mandibular arch forms are well coordinated and the casts can be easily moved into a Class I dental relationship. The treatment objectives are:

1. Maintain or even increase lower vertical dimension in order to harmonize the facial profile.
2. Respect maxillary incisor position.

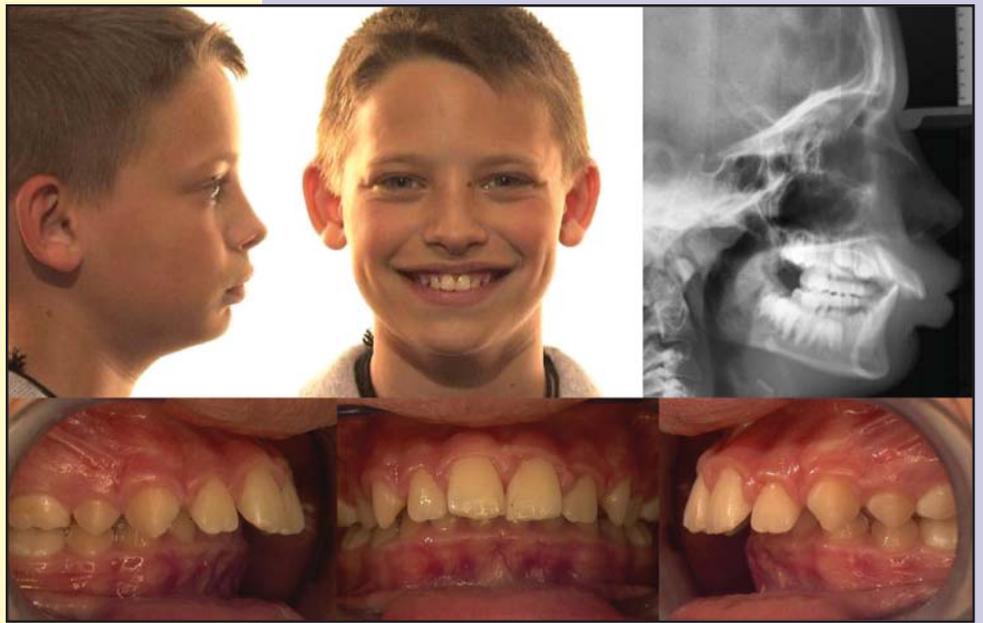


Figure 5

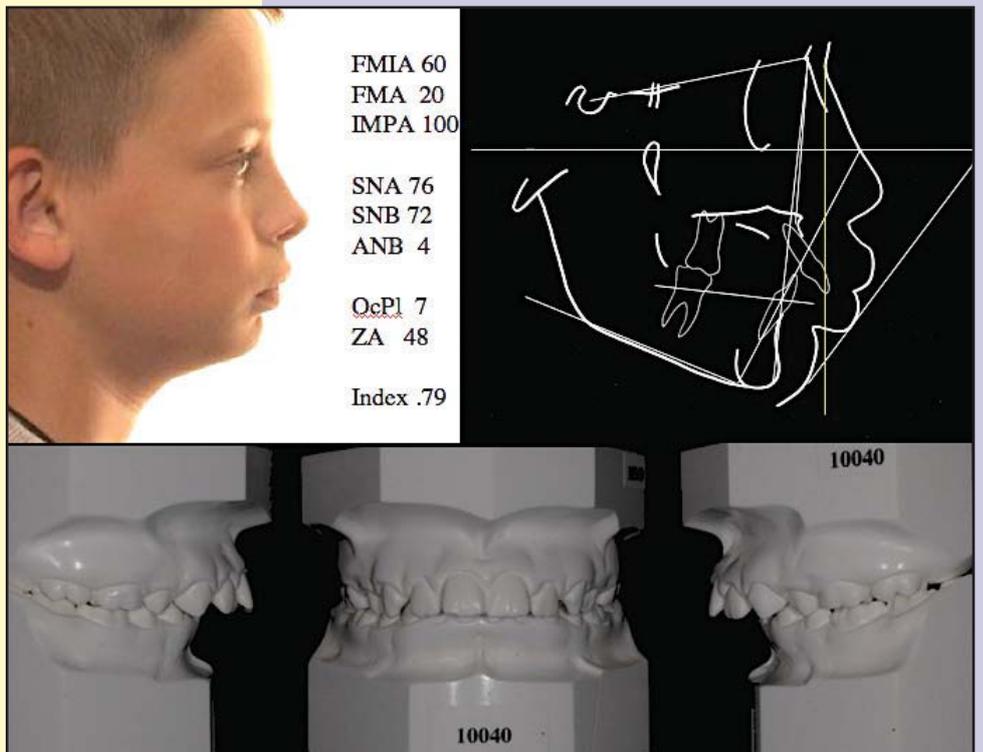


Figure 6

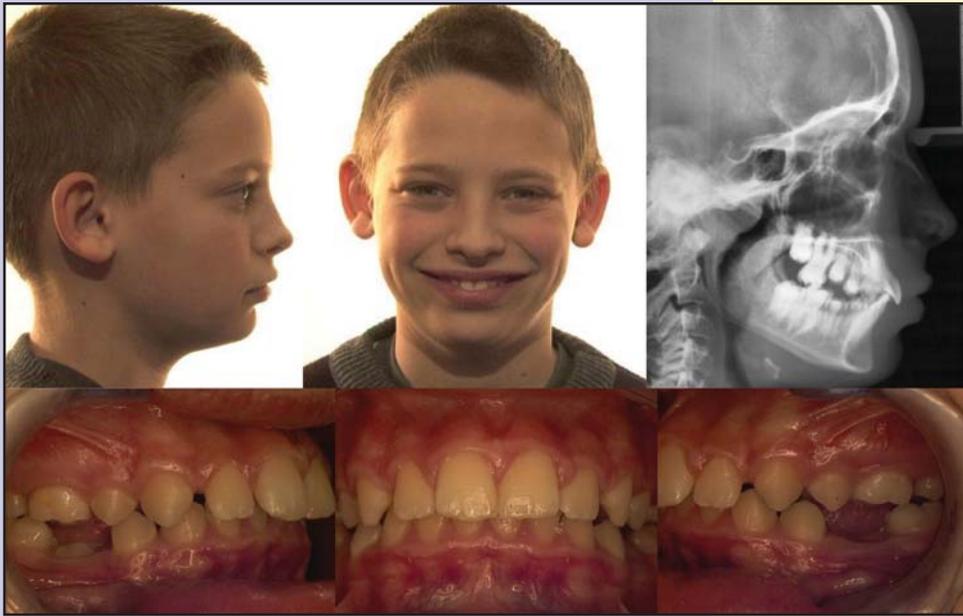


Figure 7

3. Keep the mandibular incisor in its pretreatment position (IMPA).
4. Correct the Class II relationship by enhancing mandibular growth without retracting the maxilla while using the Tweed/Merrifield treatment principles.

#### TREATMENT MANAGEMENT

An orthopedic appliance was used to posture the mandible forward. The orthopedic functional appliance was worn at night for ten months. This appliance was a combination of the Andresen activator and the lingual envelope of Bonnet. The appliance postures the mandible forward but has a functional action on tongue position and prevents thumb sucking. Its special design locks the mandibular incisor in order to maintain its angulation on the mandibular plane. The best time to achieve a good result with this appliance in the first phase is:

- A. When the second permanent molars are not erupted
- B. When the second deciduous molars are present
- C. When the maxillary and mandibular permanent canines appear

The post orthopedic records (Figure 7) show an improvement in the cephalometric values. ANB decreased from  $4^\circ$  to  $2^\circ$ . The SNB value increased from  $72^\circ$  to  $74^\circ$ . The Z angle increased from  $48^\circ$  to  $65^\circ$ . The occlusion has improved to a Class I dental relationship in the premolar areas on both sides. The patient no longer has an overjet. After Phase I, the malocclusion is easy to re-evaluate. The total space analysis shows a total dentition deficit of 6.4 mm which is exclusively located in the anterior area due to the “theoretical relocation” of the mandibular incisor. A full bonded Tweed/Merrifield appliance was placed to achieve treatment objectives.

In the mandibular arch the objectives were leveling and idealization of arch form. In the maxillary arch the objective was correction of the maxillary anterior overjet and overbite with closing loop archwires and occlusal finishing archwires (Figure 8). The second phase of treatment took 14 months. The posttreatment records show a well balanced face and a very pleasant smile (Figure 9). On the pretreatment/posttreatment superimposition (Figure 10) an increase in the lower facial height was noticed. This increase in lower facial height is associated with a forward movement of the mandible which is due to both functional orthopedics and Merrifield mechanics. Total treatment time was 24 months (Figure 11).

#### AUDREY

Audrey is a 9 year old female. She presented with a severe Class II malocclusion and a normodivergent growth pattern. The mandibular incisors impinge on the palatal mucosa. The pretreatment photographs (Figure 12) show an unbalanced profile, upper lip protrusion, and a retrognathic chin. Her frontal smile is well balanced. On the profile smile, the maxillary incisor crosses the Dreyfus plane and the labial inclina-

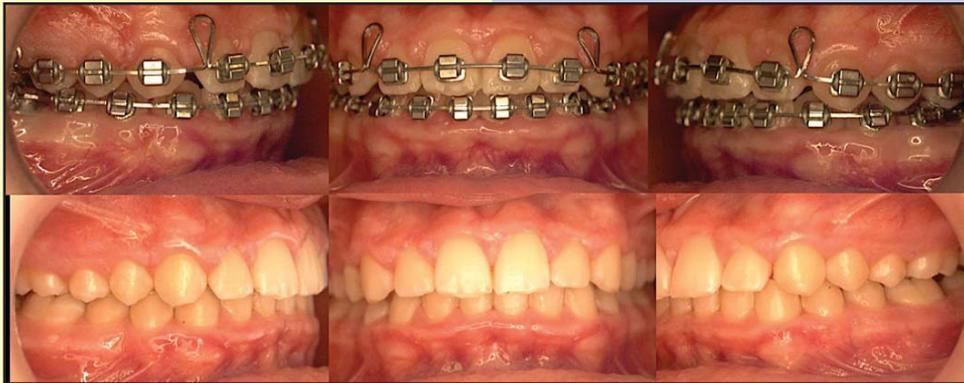


Figure 8

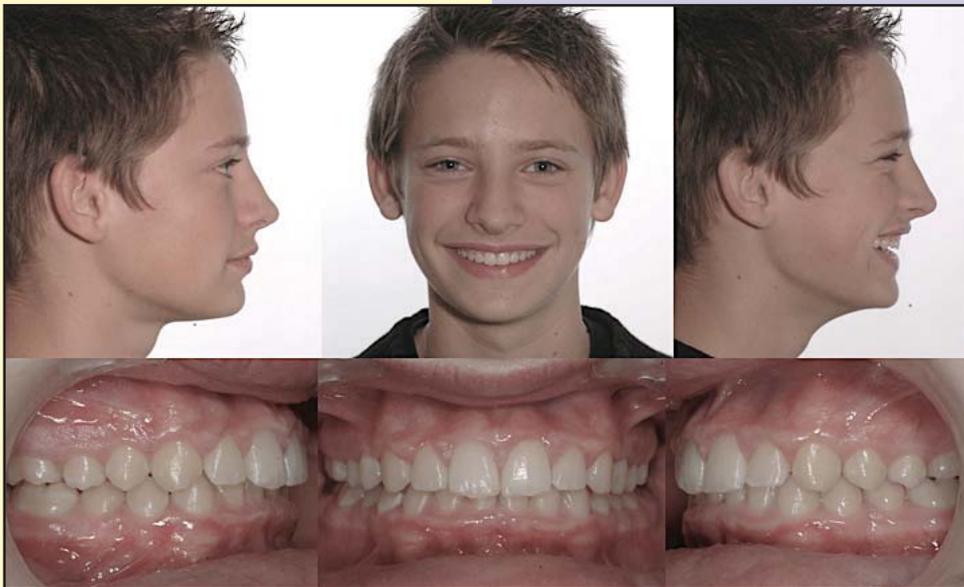


Figure 9

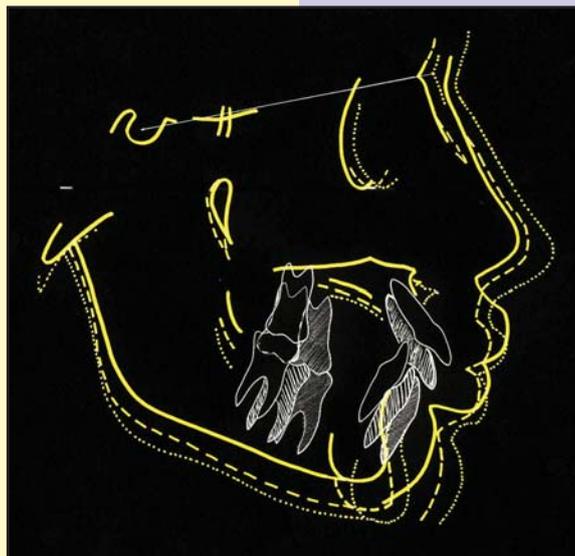


Figure 10

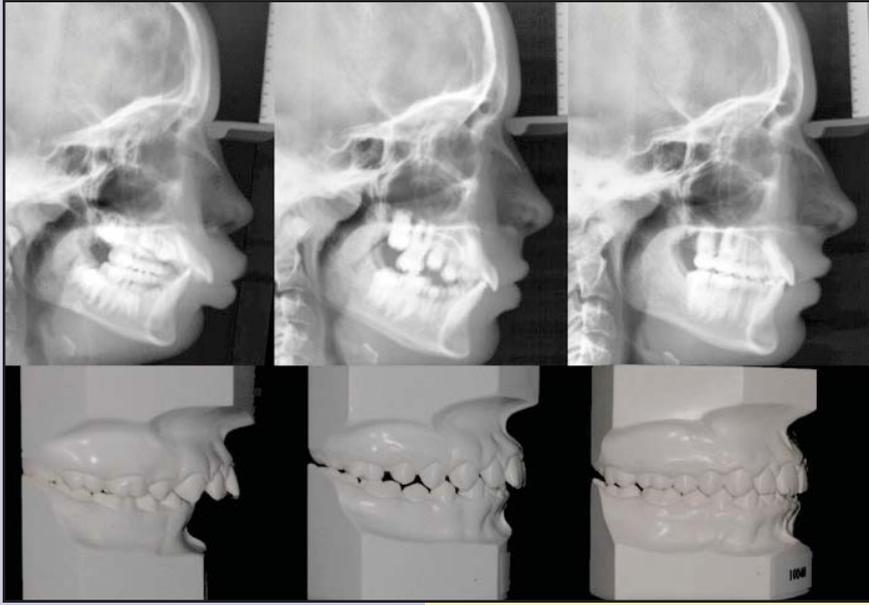


Figure 11

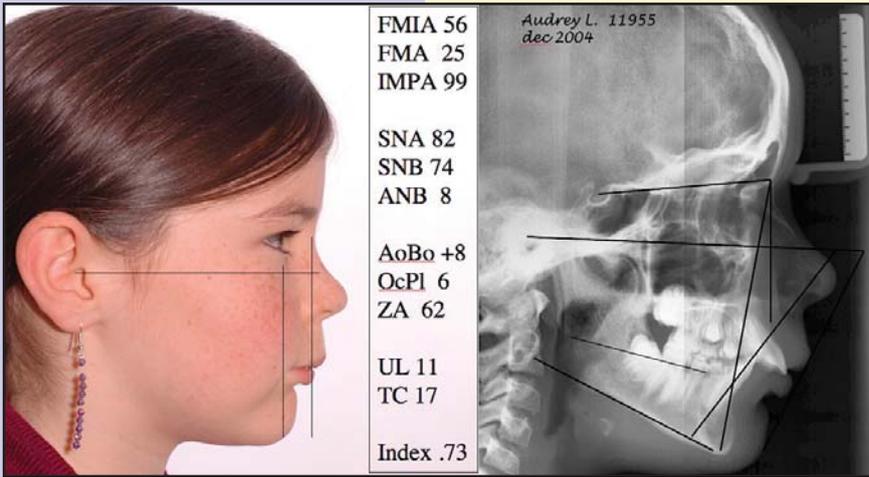


Figure 12



Figure 13



Figure 14



Figure 15



Figure 16

tion must be corrected. (Figure 13) The pretreatment cephalometric tracing (Figure 12) confirms a skeletal Class II problem with an ANB of  $8^\circ$ . SNA is  $82^\circ$  so the maxilla is well positioned in relation to cranial base. The SNB angle of  $74^\circ$  confirms mandibular retrusion. The Z Angle of  $62^\circ$  reflects the unbalanced face due to the retrognathic chin. However, the chin is located in the mandibular space between the Dreyfus and the Simon planes. This patient has a good prognosis because vertical values confirm a normodivergent skeletal pattern. The FMA is  $25^\circ$  and the FHI is .73. FMIA is  $56^\circ$  and the IMPA is  $99^\circ$ . Because there was no crowding,

the objective was to keep the mandibular incisor in its pretreatment condition. The pretreatment casts (Figure 14) reveal a Class II dental relationship on both sides. There is a mild midline deviation toward the left side, a deep overbite and an overjet of 14 mm. The second molars are not erupting.

**TREATMENT OBJECTIVES:**

Because of the fracture risk of the maxillary incisors, the dental age of patient, the growth potential, etc., a two phase treatment plan was established. The first phase objective was to correct the skeletal Class II with



Figure 17

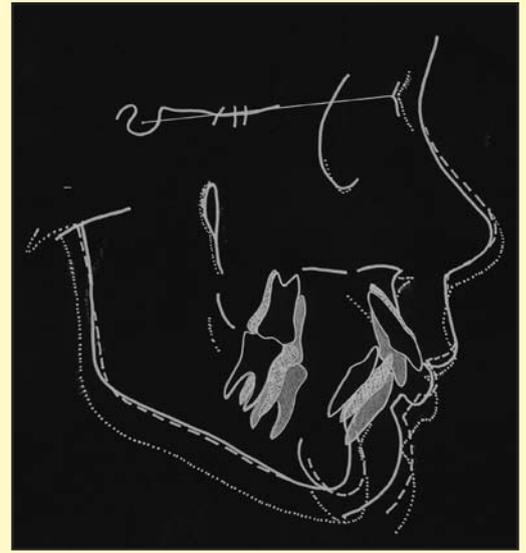


Figure 18

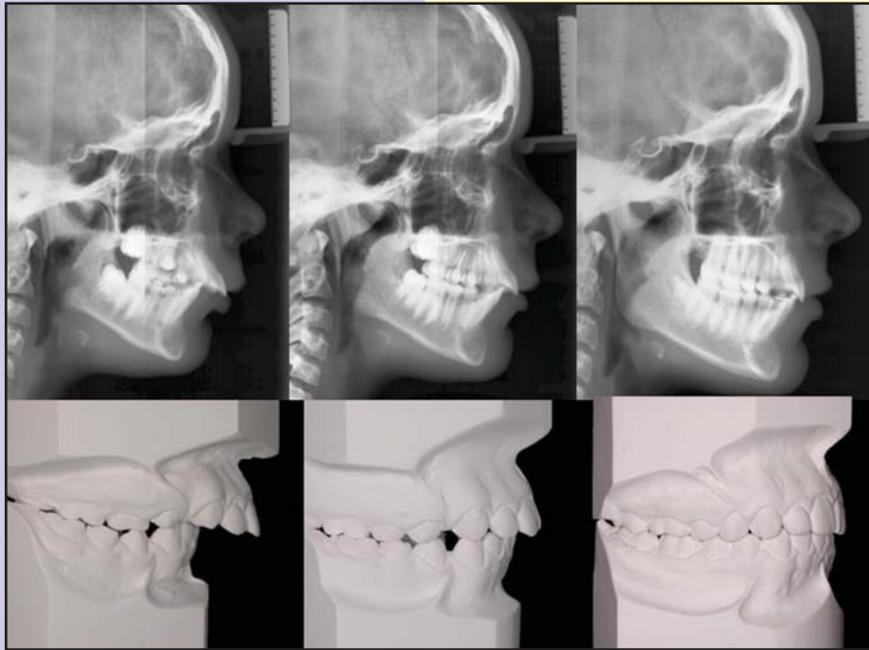


Figure 19

an orthopedic functional appliance. The second phase objective was to correct the occlusion with Tweed Merrifield Class II mechanics.

**TREATMENT RESULTS:**

After nine months of night time activator wear another set of records was made. The post orthopedic intraoral and facial photographs (Figure 15) show significant improvement. There is a Class I relationship on the left

side and an end-to-end relationship on the right side. Overjet has decreased. The first phase of treatment has improved facial balance by accelerating the mandibular change. The second phase of treatment was done with Tweed/Merrifield forces. Asymmetrical Class II mechanics were used (Figure 16). The posttreatment records (Figure 17) show overjet and overbite correction, a well balanced face and a pleasant smile.

By initiating orthodontic treatment in the mixed dentition, the need for complex treatment was significantly reduced. The closing of the horizontal planes permitted the FMIA to be increased to 60°. The IMPA remained at 99°. On the general superimposition (Figure 18) one can see the growth response to the overall treatment allowed the chin to be positioned in a downward and forward position so that the profile line to nose relationship and the Z Angle have improved.

The mandibular incisor position remains the same despite orthopedics and Class II mechanics (Figure 19). For this patient, another treatment plan could have been the extraction of maxillary first and mandibular second premolars but the maxillary incisor distal relocation would have limited the mandibular response and the increase of lower facial height. This two-phase treatment protocol seemed to give a favorable improvement of the soft tissue profile.

#### CONCLUSION:

The following questions should be asked:

Should the clinician always wait for the eruption of the permanent dentition? Should one “interfere” early? Some think that the question is really a question of management, cost and timing. I maintain that these arguments are those of the commercial markets and not of biologists and clinicians. Because we are very familiar with functional appliances in Europe, it is not a problem to use them just before full bonded appliance therapy. This treatment protocol is ideal for the low angle Class II patient. Indeed, at the end of treatment the casts of patients treated with two phases or with one phase might look the same on the table, but the face’s harmony might not be the same. “**Faces First**” must be our first priority