Time for a paradigm change

Drs. Larry W. White, Reginald W. Taylor, and Matt Brown discuss diagnosis, treatment planning, and therapy for Class II malocclusions that rely on a blend of techniques

Educational aims and objectives

This clinical article aims to discuss a paradigm for diagnosis, treatment planning, and therapy for Class II malocclusions that rely on a blend of techniques.

Expected outcomes

Orthodontic Practice US subscribers can answer the CE questions on page XX to earn 2 hours of CE from reading this article. Correctly answering the questions will demonstrate the reader can:

- Realize some historical background behind treatment for Class II malocclusions.
- Recognize some challenges to the commonly accepted paradigm for treatment for Class II malocclusions.
- Recognize some drawbacks to the reliance on the mandibular incisor position and inclination as the determinant of orthodontic therapy.
- Observe two patients treated with this new paradigm in mind.
- Recognize the essential task of deciding on the principal etiology and then planning and applying correct therapies.
- Realize that using the maxillary incisor as a guide, along with properly done VTOs, can develop reasonable targets for incisor positions, and once established, said objectives can help orthodontists design their treatment mechanics to achieve those goals.

Introduction

First impressions often endure far beyond their usefulness, and that seems particularly true with professional preferences. Orthodontics' first and only instrument for treating protruded maxillary incisors and mandibular incisors was a headgear of some design, and even into the 1980s, this therapy remained a mainstay for the correction of Class II and Class III malocclusions.

For many years, the principal therapy applied to both Class II and Class III malocclusions was some type of cranial-supported force to the maxilla or mandible (Figures 1 and 2). It was not until Calvin S. Case[1] and Henry A. Baker developed the use of intermaxillary elastics late in the 19th century that clinicians had effective and easily applied forces for addressing sagittal discrepancies.

The belief orthodontists developed from this early headgear therapy considered the maxilla and its dentition as the principal etiology of Class II malocclusions, and this paradigm has persisted even to this day evidenced by the pervasive development and employment of Class II "distalizers."

This article will offer a different paradigm for the diagnosis, treatment planning, and therapy for Class II malocclusions that rely on a blend of labors previously presented by several astute researchers and clinicians.

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Solidifying the paradigm

By the time Tweed[2] popularized the extraction of premolars, the paradigm of maxillary etiology for Class II malocclusions was well established, and his reliance on positioning the mandibular incisors at 90° ± 3° to the mandibular plane further necessitated retraction of the maxillary dentition because once the mandibular dentition retracted to this new upright position, the maxillary dentition had to retract to allow proper overjet and overbite. This maxillary retraction necessitated the use of varying types of occipital anchorage along with robust Class II and Class III elastics.

Soon after Tweed had developed his diagnostic Tweed Triangle, Cecil Steiner[3,4,5] created a diagnostic regimen using cephalometric standards that ostensibly placed the mandibular incisors into ideal positions.

Figure 1: Cranial strap to limit mandibular growth

Figure 2: Occipital pull facebow to control maxilla and maxillary incisors

Although Tweed and Steiner used different methods, the final decision of whether to extract premolars more often than not coincided.[6] These two diagnostic and treatment-planning systems dominated orthodontic diagnosis and treatment planning for about 4 decades.

Interestingly, neither in their treatment-planning boxes considered the maxillary incisors. One of the first to challenge the maxillary etiology for Class II malocclusions was McNamara.[7] While studying components of Class II malocclusions in 9-year-olds, he found mandibular deficiencies and/or neutral maxillae in approximately 87% of the examined Class II patients. Thus he considered mandibular deficiencies as a principal feature of Class II malocclusions and shifted the blame from maxillary protrusions as the etiology. Others[8,9] have made similar discoveries, and this has reinforced the emphasis on protrusion of mandibular dentitions as desired therapy for those patients. However, Mastorakas[10] in a 1983 thesis discovered in a group of 12 to 14-year-olds with Class II malocclusions that protrusive maxillae persisted more often than those in the 9-year-olds of McNamara's study and, rather than clarifying the subject, led to some confusion about the etiology of Class II malocclusions.

Even with the development of A point-Pogonion line as a diagnostic and treatment-planning guide first suggested by Williams[11] and later endorsed by Ricketts,[12] the emphasis continued on using the position of the mandibular incisors as the focus of diagnostic and treatment planning. Williams suggested placing the mandibular incisors on or within 1 mm of the APo line. Ricketts eventually expanded the acceptable position to 2 mm, but 1 mm or 2 mm provides a narrow limit for acceptable positions of the mandibular incisors and, though more generous than either the Tweed or Steiner, still required the maxillary dentition to conform to restricted mandibular incisor positions.

Casko and Shepherd[13] completed perhaps the most important and yet most neglected study ever done on adults with orthodontically untreated Class I occlusions and attractive faces. They discovered "normal" Class I occlusions with attractive faces occurred within wide ranges, for instance:

- ANB angle ranged from -3° to 8°; (an example herewith extends this to 10°)
- Maxillary incisor to SN ranged from 93° to 120°
- Mandibular incisor to APo ranged from -3 mm to 6 mm
- IMPA ranged from 83° to 106° (an example herewith extends this to 114°)

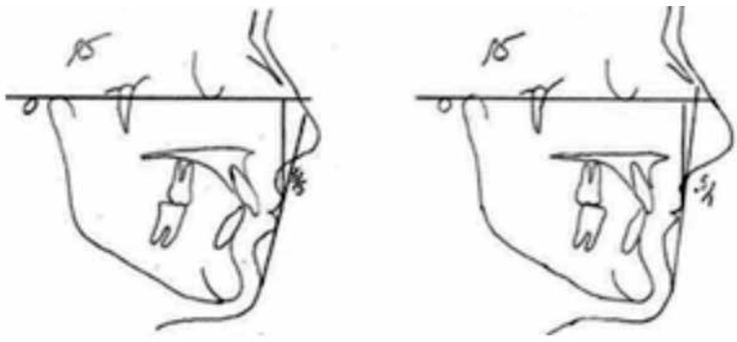


Figure 3: Cephalometric tracings of a patient with ideal facial measurements — (left) prior to therapy with four premolar extractions suggested by the Tweed Triangle; (right) an unappealing streamlined profile. Illustrations used with permission of the *American Journal of Orthodontics & Dentofacial Orthopedics*

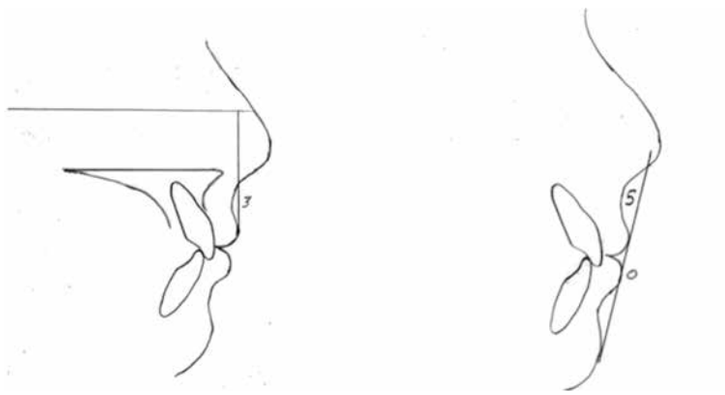


Figure 4: Holdaway's subnasale sulcus is on the left, while the H line is on the right along with their measurements of 3 mm and 5 mm

They found a strong correlation between the A-B discrepancy and the position of the mandibular incisors. As the distance of A to B enlarges, the mandibular incisors must lean more forward to make contact with the maxillary incisors. As the distance between A and B diminishes, the mandibular incisors adapt more lingually.

A few years later, McNamara[14] made a similar study of Class I adults with ideal occlusions and attractive faces and corroborated what Casko and Shepherd had previously found. Even Tweed[15] had previously discovered a wide range of measurements within his partisan collection of Class I occlusions accompanied by straight profiles or slightly concave, which he preferred. Why he decided on placing mandibular incisors at 90° ± 3° to the mandibular plane remains a mystery. But the profession endorsed it and continues to use it despite its serious limitations.

Challenges to the commonly accepted paradigm

Holdaway[16,17] first suggested using the maxillary incisor rather than the mandibular incisor as a guide for diagnosis and treatment planning. Ostensibly, the maxillary incisor bears the primary responsibility for lip support, and the frequent loss of lip support he and others received from using the mandibular incisor for treatment planning precipitated the necessity of using soft tissue as a guide (Figure 3).

Others,[18-21] alluding to Casko's and McNamara's studies, soon added to Holdaway's seminal suggestion about deferring to the face, the upper lip, and the maxillary central incisors as determinates of where to position the maxillary and ultimately the mandibular incisors. Unfortunately, few clinicians seem to know about Holdaway's discoveries, much less subscribe and use them.

Holdaway's cephalometric analysis, which incidentally applied only to Caucasian faces, has two important measurements for maxillary lip position (Figure 4):

1. The subnasale sulcus measurement that extends a perpendicular line from Frankfort Horizontal to the outer contour of the upper lip and ideally measures 3 mm ± 1 mm;
2. The harmony or H line uses a line from the soft tissue pogonion to the outer contour of the upper lip and ideally measures 5 mm ± 1 mm.

Obviously, different racial types along with

doctor discretion and patient preferences require accommodations, but the contention that the maxillary incisor essentially controls lip posture is obvious. By making it the cornerstone of diagnosis and treatment planning, clinicians can avoid streamlining the profile.

The A Line diagnosis and treatment-planning system

In 2001, Alvarez[18] published an article that presented his findings vis-a-vis Casko's study of Class I occlusions. He discovered that the facial surface of the maxillary central incisors in those patients occupied a position that was one-third ±1 mm of the distance between soft tissue A point and osseous A point, which he called the A Line (Figure 5).

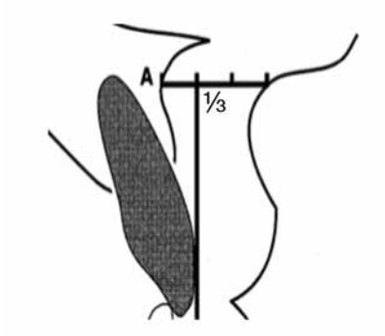


Figure 5: The A Line — a perpendicular line extended from a line parallel to true horizontal to a point one-third of the distance between osseous A point and soft tissue A point

A case in point

The following orthodontically untreated individual (Figures 6 and 7) illustrates exactly what Casko, Shepherd, McNamara, Holdaway, Alvarez, Bass, Creekmore and others were convinced of: i.e., the mandibular incisor varies in its position to the maxilla and its dentition, and that the maxilla and its dentition carries the responsibility for the contour of the lips and the facial profile. Therefore, the diagnostic dynamic should rest upon the maxillary incisors rather than the mandibular. These discoveries, however difficult for some to accept, invalidates the reliance on the mandibular incisor position and inclination as the determinant of orthodontic therapy.

This young lady has an ideal profile with Holdaway measurements of 3 mm and 5 mm for the subnasale and H line, respectively. She also displays an ideal Class I occlusion untouched by orthodontic treatment. But interestingly, she has an A-B discrepancy of 12 mm (an ANB discrepancy of 10°), which is 3 times what is conventionally regarded as ideal. Consequently, the mandibular incisor has an IMPA of 114°, which is 24° from the upright position suggested by Tweed. Additionally, the mandibular incisor lies 5 mm ahead of the APo line and exceeds Williams' suggested position by 4 mm and even what Ricketts suggested by 3 mm. However, note that the interincisal angle for such an individual with an A-B discrepancy of 12 mm is ideal at 115°. The lower lip lies -1 mm from the H line, which is within the range of ideal suggested by Holdaway. The maxillary incisor lies 1 mm anterior to the A Line, which is within the range of ideal suggested by Alvarez.

Clinical examples of soft tissue diagnosis, treatment planning, and therapy

Patient 1

The following 11-year-old adolescent female (Figure 8) had a maxillary arch length discrepancy of 7 mm, whereas the mandibular arch length discrepancy measured 13 mm with a blocked-out mandibular left second premolar. She also displayed features of a maxillary protrusion and a mandibular retrusion, but the principal trait was the mandibular retrusion caused primarily by a short mandible.

The maxillary central incisors showed a slight protrusion (2 mm anterior to the A Line) reinforced by a lower lip bite habit, whereas the maxilla itself had an optimal length. The protruded maxillary incisors, which lay 2 mm anterior of the A Line, caused some lip strain in the upper lip, but the subnasale sulcus measurement registered only 1 mm, which is sub-minimal for an esthetic face. The harmony line of Holdaway measured an unusually large 10 mm due to the retrusive mandible. These soft tissue measurement of the lips resulted in a seemingly protrusive profile that was more true in appearance than reality. The short mandible contributed appreciably to the large A-B discrepancy of 12 mm as opposed to the average of 4 mm

Figure 6: An ideal orthodontically untreated face and dental occlusion

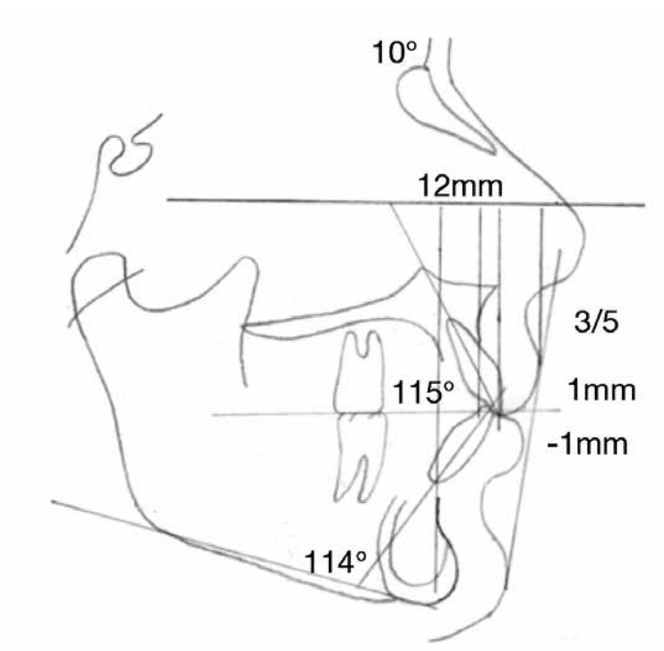


Figure 7: Cephalometric tracing of the ideal untreated face and dental occlusion

Figure 8: Adolescent female Class II Division 1 malocclusion complicated by maxillary and mandibular arch length discrepancies and a short mandible with a retruded mandibular dentition

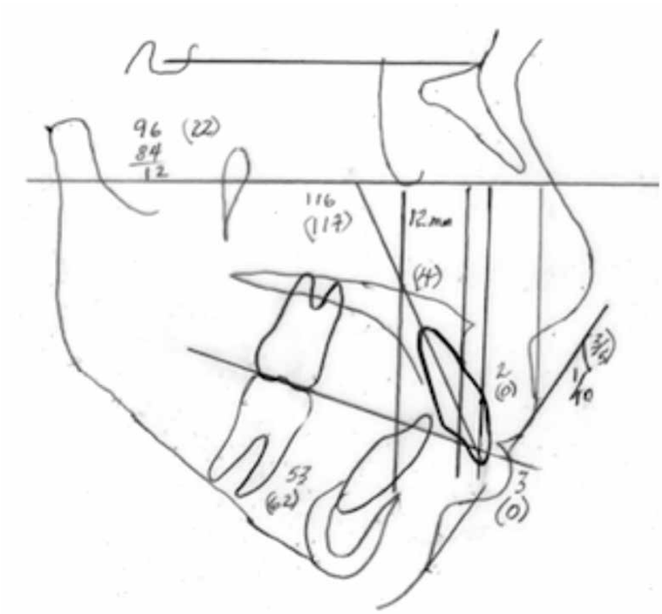


Figure 9: Initial cephalometric tracing of malocclusion

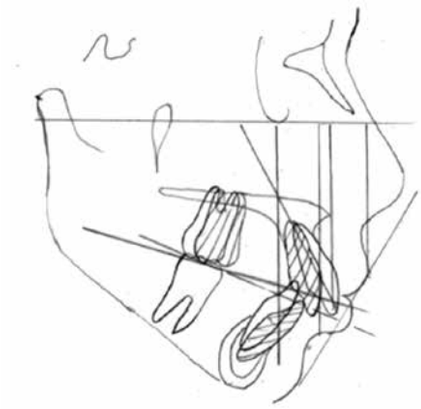


Figure 10: Visualized Treatment Objective (striation) superimposed on the initial tracing

Cephalometric Values		
	Norm	**Patient**
Upper Lip Sulcus	3	1
Upper Lip Sulcus to H Line	5	10
Maxillary Incisor to A Line	0	2
Lower Lip to H line	0	3
Md to Mx difference	22	12
Lower Anterior Face Height	63	53
A-B Discrepancy	4	12

Modified Steiner Box		
	Max	**Man**
Arch Length Discrepancy	-7	-13
Arch Development		
Relocation Incisor	-5.5	10
Mesial Molar Movement	-2.5	
Distal Molar Movement		
Curve of Spee		
Interproximal Reduction		3
Extractions	15	
Total Net	**0**	**0**

Figure 11: Cephalometric measurements and modified Steiner Box for treatment planning

and signaled a requirement for the mandibular incisors to need a more forward position.

The patient had a deep bite and large overjet with Class II canines and a malocclusion classified as a Class II Division 1, which some might wish to correct by intruding and retracting the maxillary incisors while they simultaneously apply a distal force to the maxillary dentition. But applying heavy distal forces to the maxilla carries the risk of extruding the maxillary molars, which would drive the mandible down and back and make the achievement of Class I canines more difficult.

The cephalometric tracing, (Figure 9) and constructed VTO (Figure 10) that changes the occlusal plane to 5 mm-6 mm below the lip embrasure (suggested for adolescents) allows one to see that the deep overbite and overjet need correction by intrusion and advancement of the mandibular incisors, along with the lingual retraction of the maxillary incisors. These cephalometric measurements, along with the arch length discrepancies, prompted the decision to remove the maxillary first premolars for space to retract the maxillary incisors and place the maxillary canines in a Class I occlusion, while bringing the maxillary posterior teeth forward and occluding in a Class II arrangement. The mandibular arch would undergo nonextraction therapy. Please refer to the modified Steiner Box (Figure 11).

Advancement of the mandibular incisors remains an anathema to clinicians weaned on Tweed, Steiner, and APo diagnoses and treatment plannings; but as Casko and McNamara have shown in previously cited studies of the variation in Class I occlusions, as the distance between point A and point B enlarges, the mandibular incisors must lean forward to have contact with the maxillary incisors.

Although this adolescent patient will continue to grow, rather than using an unpredictable chaos-ladened growth Visualized Treatment Objective (VTO), I designed this VTO as a nongrowing patient. That is, clinicians need to know what it would take right now to give this patient an acceptable overbite, overjet, and posterior occlusion while solving the arch length discrepancies.

The therapy proceeded as planned, and as seen in the final photographs, cephalometric tracings, and the cephalometric superimpositions (Figures 9-15), the treatment outcome validates that plan. The profile has improved markedly by relieving the upper lip strain and the mandibular forward growth, which also reduced the A-B discrepancy by 2 mm.

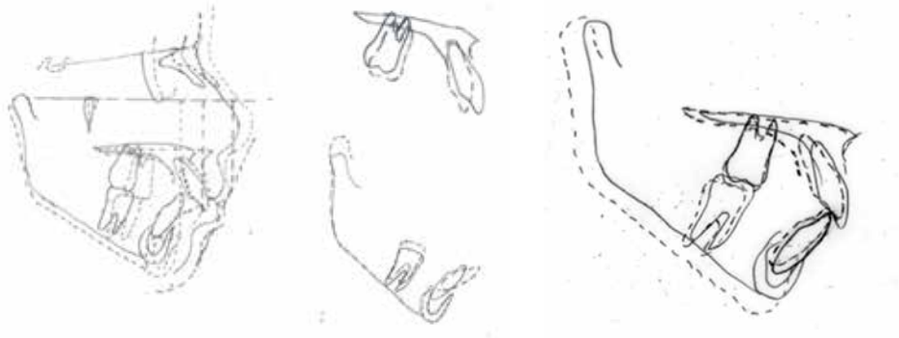
Many would dispute the wisdom of advancing mandibular incisors so far, but intruding them simultaneously will diminish the risk of stripping the gingiva, and the outcome photos illustrate that no such stripping has occurred. Additionally, those who question the advancement of mandibular incisors must realize that many times correct therapy requires such movement. Also, by superimposing on the maxilla, one can see how the maxillary and mandibular incisors have responded as planned in the VTO (Figures 14 and 15). Some clinicians additionally complain that the advancement of mandibular incisors will encourage a rapid relapse. To test this theory, the wires were left off this appliance for a range of time before removal of the brackets and bands with no apparent relapse. Once teeth have an optimal occlusion, the retention becomes self-sustaining, and this patient experienced that.

Patient 2

The following patient (Figure 16) displays a Class II malocclusion complicated by a deep bite and maxillary and mandibular arch length discrepancies. Her A-B discrepancy is 10 mm, which is 3½ times the average of 4 mm. The mandible-maxilla discrepancy is 18 mm, which indicates a short mandible. Both maxillary and mandibular incisors are retroclined and need forward positioning, while the maxillary incisors need much more axial inclination. The initial tracing and VTO (Figures 17 and 18) encourages the correction to come from forward movement of the maxillary incisors and the entire mandibular dentition. The patient's cervical vertebrae show little evidence of further pubertal growth, so any correction will come from dentoalveolar adaptation. At first glance at the VTO, it would seem impossible for that much forward movement of the mandibular dentition to occur. Nevertheless, as the final photographs and cephalometric superimpositions show (Figures 19 and 20), that occurred exactly with a "distalizing

Figure 12: Photos of treatment outcome

Figure 13: Posttreatment cephalometric values and tracing



Figures 14 and 15: 14. Superimpositions of initial and final cephalometric tracings at SN (left) and on the palatal plane and the mandibular plane (right). 15. Superimposition on the maxilla to show coincidence of the VTO teeth to those of the final positions. (VTO — solid line and final — dotted line)

Figure 16: Patient with a Class II malocclusion with a deep overbite and maxillary and mandibular arch length discrepancies

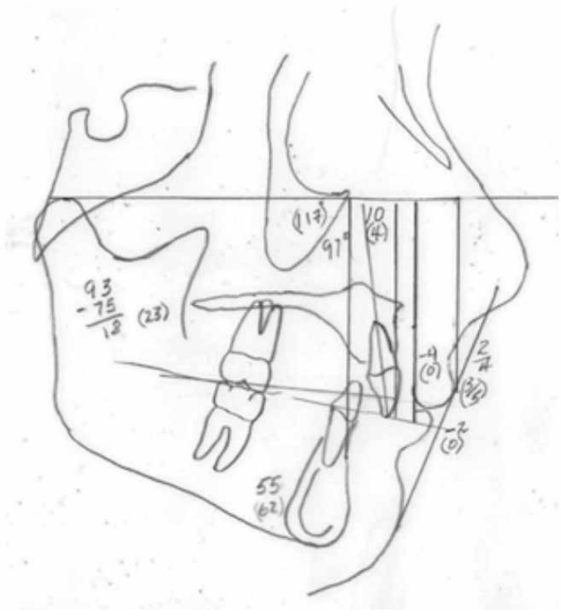


Figure 17: Initial cephalometric tracing

appliance," aka, the Forsus. Note not only how the mandibular dentition has moved forward, but also how the symphysis has bent forward from this mesial force. Simultaneously, the VTO illustrates how the maxillary incisors initially are lingual vis-a-vis the A Line and needed forward movement and more apical inclination.

Conclusion

Carl Sagan popularized the aphorism that "Extraordinary claims require extraordinary evidence." This article fulfills that requirement by relying on research by reliable investigators and the experience of both skillful clinicians and the authors. Personally, in designing treatment plans for patients with Class II malocclusions, far more retrusive mandibular dentitions are found than protrusive maxillary; and often with patients who do show protrusive maxillary dentitions, as in the first patient shown, they will concomitantly display a retrusive mandibular dentition.

Dr. Calvin S. Case (1847-1923), when he invented Class II elastics, knew he was creating both distal and mesial forces, and so it is with every intermaxillary Class II mechanism. Without many exceptions, most of the correction from so-called "distalizers" results in protraction of the mandibular dentition. When clinicians show "distalizing" effects with superimpositions, it is usually immediately after the Class II correction has occurred. Readers seldom see superimpositions made at the termination of treatment, which, more often than not, show previously retracted maxillary molars with more mesial positions and the mandibular incisors positioned more facially.

Obviously, one should not expect the treatment of two patients to engender a change in the paradigm of diagnosis, treatment planning, and therapy of Class II patients, but the previously mentioned untreated patient and the two treatments do illustrate the truths provided by multiple researchers and clinicians that question the long-held belief regarding the mandibular incisor as the key to diagnosis, treatment planning, and therapy. Additionally, this article should alert clinicians to the essential task of deciding on the principal etiology and then planning and applying correct therapies.

By using the diagnostic and therapeutic discoveries of Holdaway, Casko, McNamara, Bass, Alvarez, and others, clinicians can establish the primacy of the maxillary incisors rather than mandibular and realize that the mandibular incisor simply and naturally adapts to the position of the maxillary incisor vis-a-vis the A-B discrepancy as documented by Casko and McNamara. Establishing the mandibular incisor as the principal treatment objective, based upon a dubious supposition not always found in nature, should give pause to those who continue to insist upon its validity. No one questions the excellent therapies provided by using the mandibular incisor as a diagnostic and treatment-planning guide. But one must realize that satisfactory clinical outcomes often occur in spite of planning rather than because of it.

By using the maxillary incisor as a guide along with properly done VTOs, clinicians can develop reasonable targets for incisor positions, and once established, said objectives can help doctors design their treatment mechanics to achieve those goals. OP

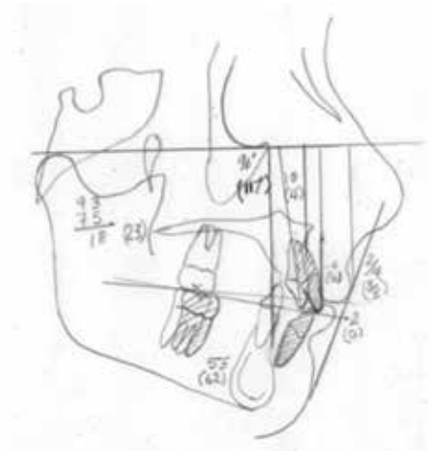


Figure 18: VTO constructed on the initial cephalometric tracing

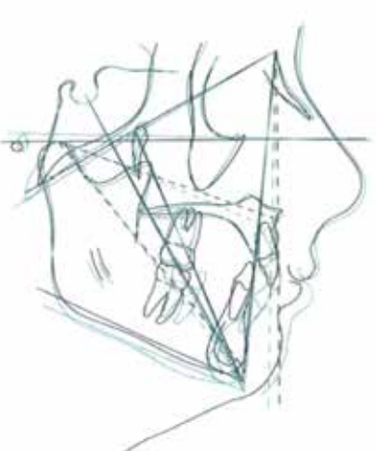


Figure 19: Final cephalometric tracing superimposed on the initial tracing at SN, which shows the forward displacement of the mandibular dentition but also the bending of the symphysis that accommodates the proper interincisal contact. Additionally, note the minimum distal movement of the maxillary molars and the lack of mandibular growth this patient experienced as the mandible dropped down and back with no forward movement

Figure 20: Photographs of treatment outcome

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