CASE REPORT

Facial balance and harmony: An attainable objective for the patient with a high mandibular plane angle

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Facial balance is an attainable goal of orthodontic treatment. If it is within the power of the orthodontist to favorably affect facial balance, doing so should be an overriding priority. The question, "What can be done to preserve or enhance facial balance, harmony, and proportion?" should be answered during diagnosis in any patient who presents for orthodontic treatment. The purpose of this paper is to offer some answers to this question when the patient has a medium to high Frankfort mandibular angle or, stated differently, a moderate to excessive anterior facial height. If facial balance is to be a reality for patients with these skeletal patterns, the following three objectives must be met during treatment: (1) The mandibular incisors must be upright or overly upright over their bony support. (2) Anterior facial height must be controlled. (3) Posterior vertical dimension must be controlled. If these three objectives are realized during active mechanotherapy of moderate- to high-angle patients, balance and harmony of the lower face should be an attainable goal. (Am J Orthod Dentofacial Orthop 1998;114:176-88.)

Facial balance and harmony, as well as ideal occlusion, should be simultaneous and equally important goals of orthodontic treatment. If facial balance does not exist, it should be an overriding priority of orthodontic treatment. The question becomes, "What can we as orthodontists do to preserve or enhance facial balance, harmony, and proportion for each of our patients?" Differential diagnostic decisions made before treatment, and orthodontic treatment mechanics used to effect tooth movement, should consistently enhance facial balance and harmony.

In the discussion of facial balance, the pivotal question becomes, "How does one define balance?" All orthodontists are familiar with Angle's concept that the Roman copy of a Greek face, Apollo Belvedere, was the most pleasing facial type.[1] The fact that the "Father of Orthodontics" touted the rather "flat" face of the Apollo is interesting because his philosophy of retaining all the teeth in the arches[2] means that only a small minority of his posttreatment faces could fit his standard.

Tweed[3-5] departed from the staunch dogma of Angle and used cephalometrics to arrive at a new standard for facial esthetics. This standard was predicated on his diagnostic triangle, with particular emphasis on the Frankfort mandibular incisor angle (FMIA) (Fig. 1). Tweed stated that a patient with a posttreatment FMIA between 60° and 70° had a balanced face.[6] Tweed's standards led orthodontics into the extraction of the four first premolars when extractions were required.[7] In Tweed's era, there was no differential diagnosis and no variance of the extraction pattern in the interest of facial balance.

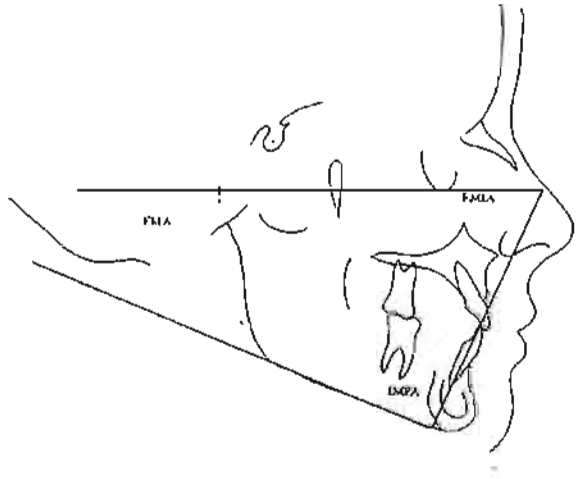

Fig. 1. Tweed's diagnostic facial triangle.

Merrifield initiated a study of facial balance and facial esthetics in the early 1960s. He studied the profile line and its relationship to the lips, as well as the angle it made with the Frankfort horizontal plane. He published his findings in 1966.[8] His article "The Profile Line as an Aid in Critically Evaluating Facial Esthetics" gave the specialty a way to quantify balance and harmony of the lower facial profile. His Z-angle (Fig. 2) is an excellent diagnostic tool, and

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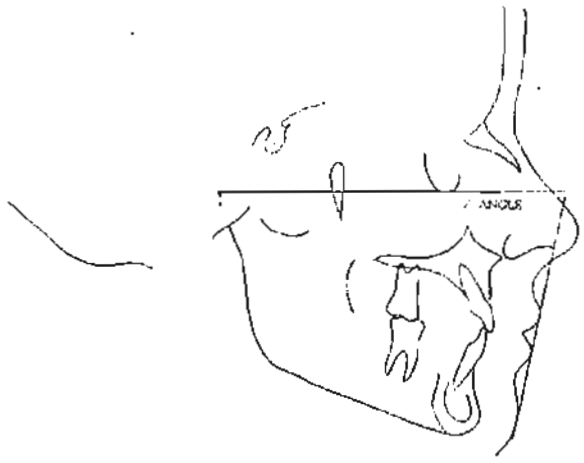


Fig. 2. Merrifield's Z-angle.

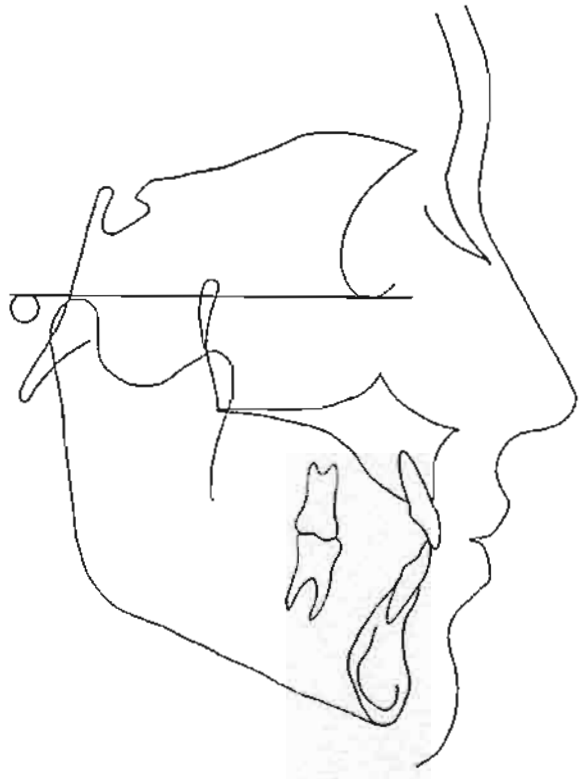


Fig. 3. Computer-generated polygon of the ideal facial profile of the adult white male. (Reprinted with permission from Czarnecki ST, Nanda RS, Currier GE: Perceptions of a balanced facial profile. Am J Orthod Dentofac Orthop vol 104:108-7. Copyright © 1993 by the American Association of Orthodontists.)

it directly reflects soft tissue response to tooth movement. The most appropriate range for the Z-angle is 72° to 78°.

In the ensuing decades, studies reported by Burstone,[9,10] Zylenski,[11] Hsu,[12] Bishara,[13] and McNamara[14] have further clarified the facial-balance dilemma for the specialty. In 1970 Peck and Peck published the results of a study of facial balance of 52 individuals deemed to have pleasing facial esthetics.[15] This study confirmed the diversity of facial

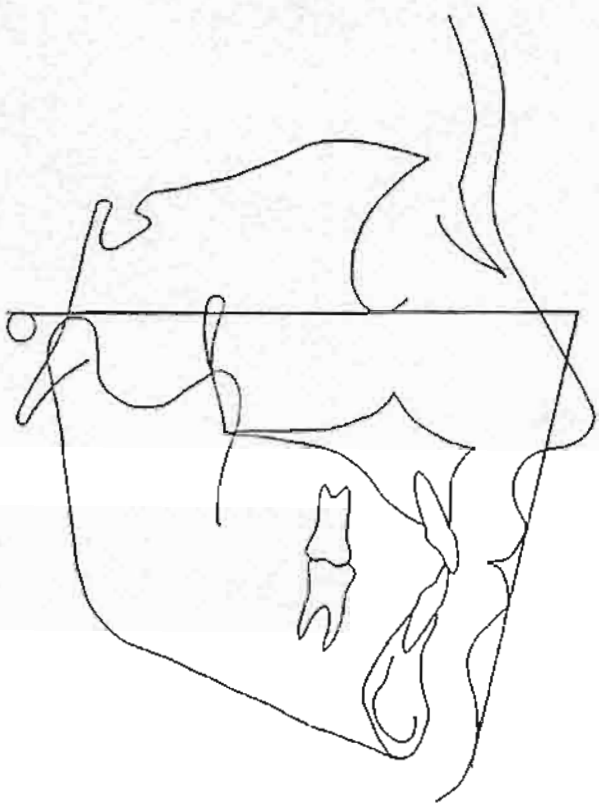


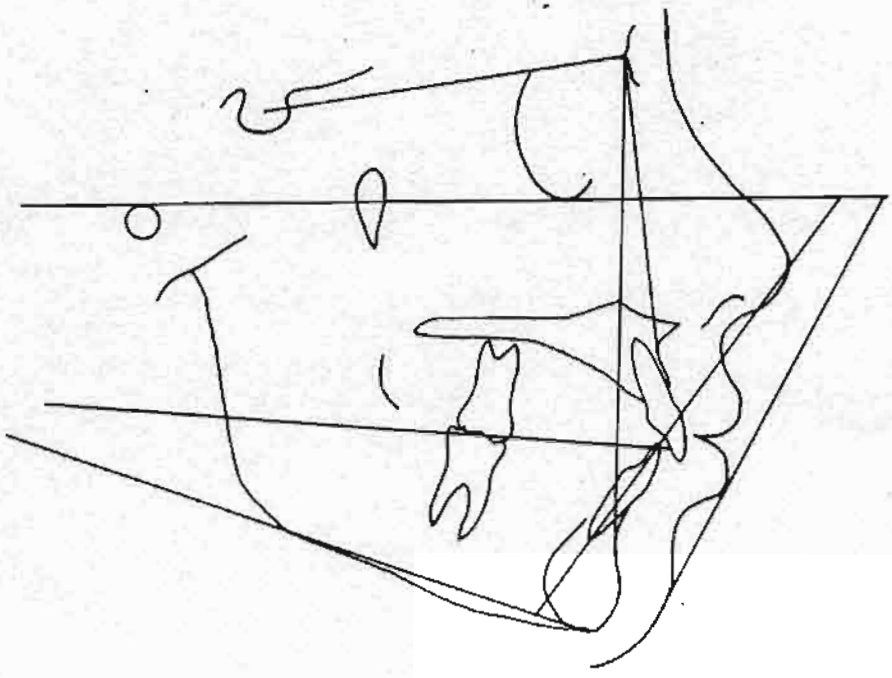
Fig. 4. The Z-angle, drawn on the computer-generated ideal facial profile.

Fig. 5. Pretreatment facial photographs.

form in our population and broadened the range of what the specialty could accept. Twenty-three years later, Czarnecki, Nanda, and Currier[16] published the results of a study of what the public now perceives as a balanced face. These authors developed a computer-generated polygon of an adult white man with "ideal" facial balance (Fig. 3). It is interesting to note that when Merrifield's Z-angle is drawn on this ideal facial polygon (Fig. 4), the value is 77°, confirmation that the Z-angle is valid when facial balance is studied and evaluated.

Completing the circle was the Johnston and Luppanapornlarp study of the facial esthetics of a clear-cut extraction sample versus a clear-cut non-extraction sample.[17] The authors stated, "It should not be inferred, however, that the extraction profiles were too flat on recall. Instead, it was the non-extraction patients who tended to have concave faces,, whereas the extraction patients more often had what non-extraction advocates might call a nice, full, pleasing profile."[17]

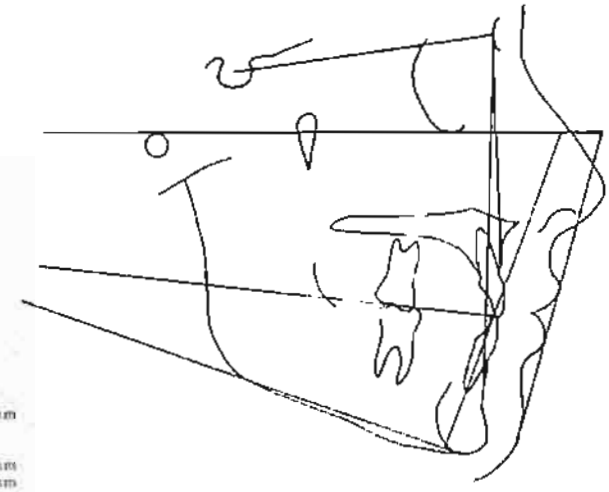
Because there appears to be agreement as to



R. B.
Pretreatment

FMIA	53
FMA	21
IMPA	106
SNA	88
SNB	80
ANB	8
AO-BO	6mm
OCC	8
Z	62
UL	12mm
TC	9mm
PFH	54mm
AFH	62mm
Index	87

Fig. 6. Pretreatment cephalogram tracing.



R. B.
Posttreatment

FMIA	68
FMA	20
IMPA	92
SNA	85
SNB	82
ANB	3
AO-BO	2mm
OCC	8
Z	75
UL	15mm
TC	13mm
PFH	58mm
AFH	65mm
Index	89

Fig. 7. Posttreatment cephalogram tracing.

what balanced faces look like, the question, "How can orthodontists favorably affect facial balance?" becomes fundamental. The purpose of this article is to offer some answers to this question when the patient has a medium to high Frankfort mandibular angle (FMA) or, stated differently, a moderate to excessive anterior facial height.

The patient with a decreased anterior vertical dimension (a low FMA) is not the central focus of this study. A completely different set of tenets must be applied during the diagnosis and treatment planning of the low-angle skeletal pattern. Every clinician is aware that some of these patients, even though they have low FMAs, require extraction and

Fig. 8. Posttreatment facial photographs.

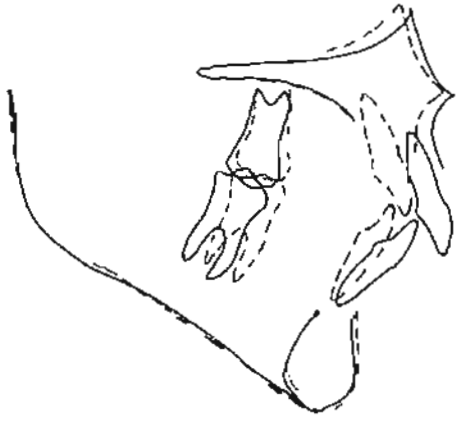


Fig. 9. Mandibular incisors must be uprighted so the maxillary incisors can be intruded as they are retracted.

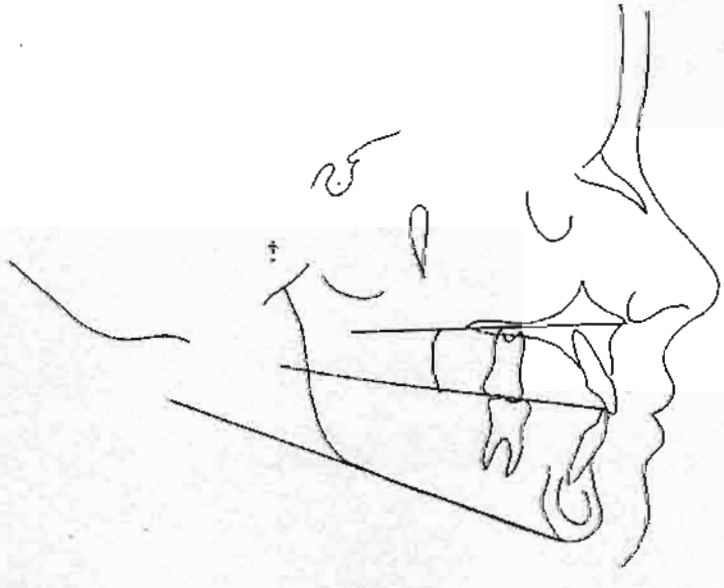


Fig. 10. Vertical and rotational control of the palatal plane, occlusal plane, and Frankfort plane.

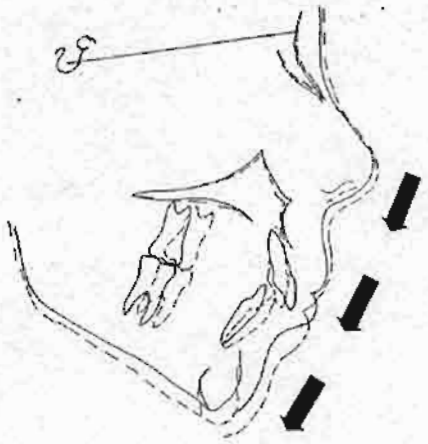


Fig. 11. Downward and backward mandibular spatial change.

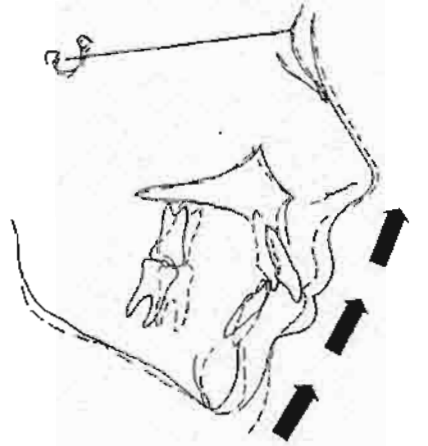


Fig. 12. Upward and forward mandibular spatial change.

Fig. 13. Pretreatment facial photographs from patient 1.

some mandibular incisor uprighting. The pretreatment facial photographs (Fig. 5) and pretreatment cephalogram tracing (Fig. 6) of a patient who had an FMA of 21° illustrate this point. After premolar extraction and uprighting of the mandibular incisors from 106° to 92° (Fig. 7), the patient has much better facial balance (Fig. 8). Likewise, there is a segment of this "low angle" patient population for

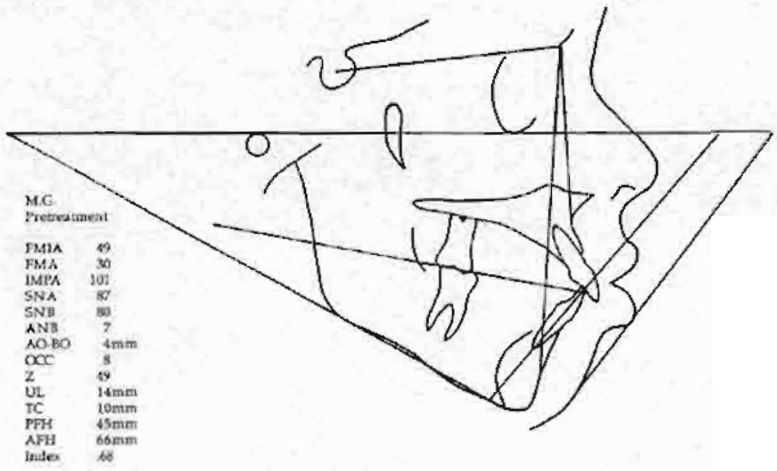


Fig. 14. Pretreatment cephalogram tracing from patient 1.

Fig. 15. Posttreatment facial photographs from patient 1.

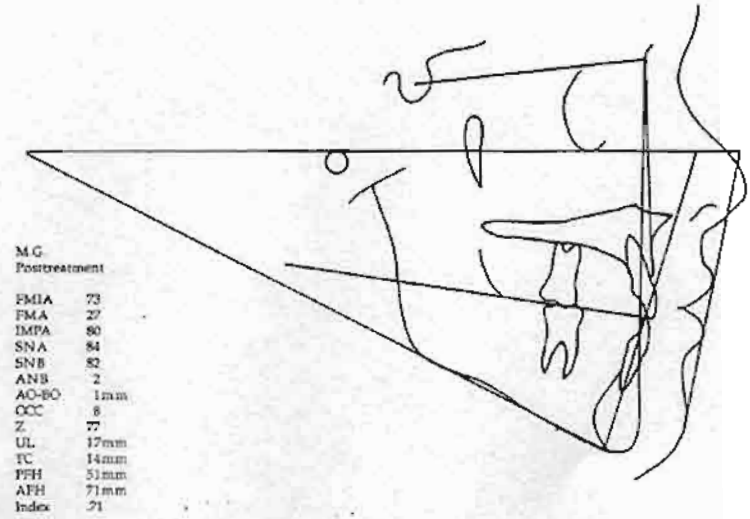


Fig. 16. Posttreatment cephalogram tracing from patient 1.

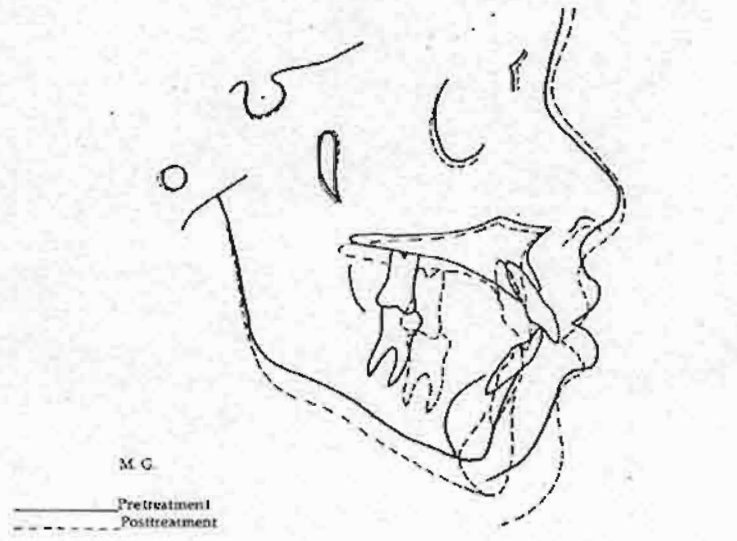


Fig. 17. Pretreatment/posttreatment tracing superimpositions from patient 1.

Fig. 18. Pretreatment facial photographs from patient 2.

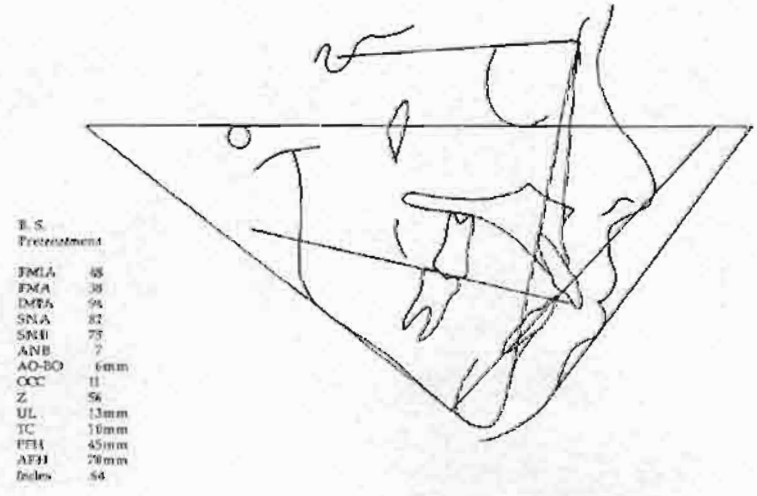


Fig. 19. Pretreatment cephalogram tracing from patient 2.

Fig. 20. Posttreatment facial photographs from patient 2.

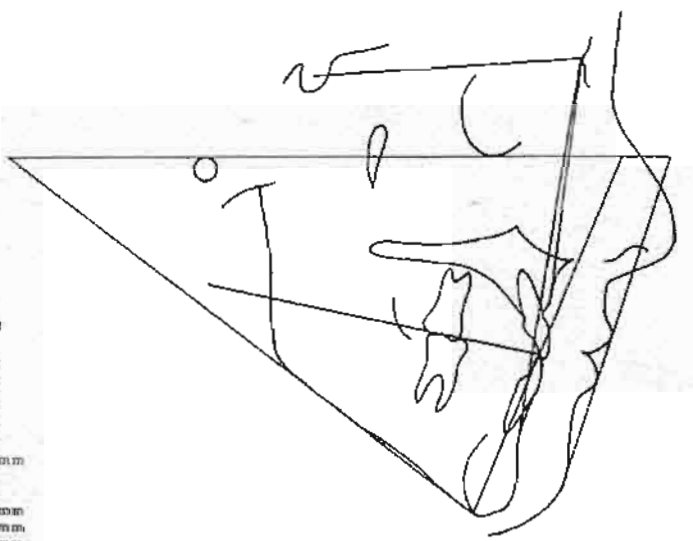


Fig. 21. Posttreatment cephalogram tracing from patient 2.

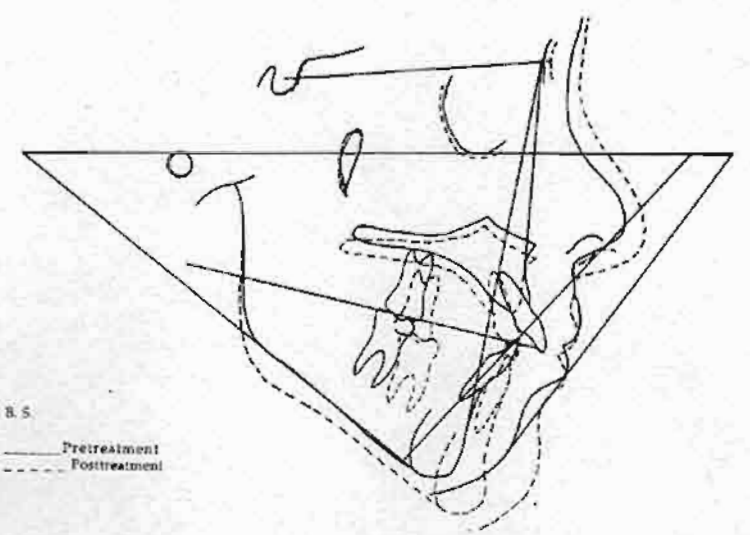


Fig. 22 Pretreatment/posttreatment tracing superimpositions from patient 3.

Fig. 23. Pretreatment facial photographs from patient 3.

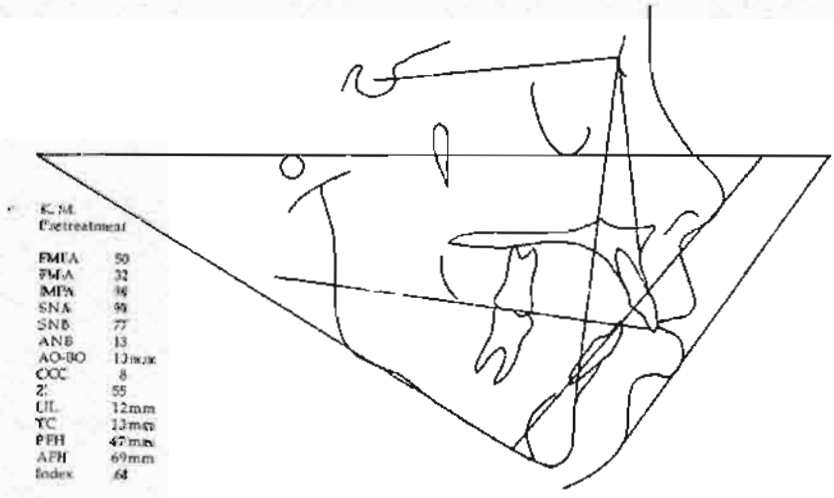


Fig. 24. Pretreatment cephalogram tracing from patient 3.

whom mandibular incisor uprighting is contraindicated. Their malocclusions must be corrected without mandibular premolar extraction. The diagnostic and treatment concepts most appropriate for this patient population have been described by Noffel,[18] Lamarque,[20] Vaden,[20] and others.

If posttreatment facial balance is to be a reality for patients with average to high FMAs, the following three treatment objectives should be achieved during orthodontic mechanotherapy.

Objective 1: Mandibular Incisors Must Be Upright Over Their Bony Support After Treatment

Uprighting of mandibular incisors is fundamental to the achievement of balance and harmony of the lower face (Fig. 9). Angle stated that mandibular lip curvature was determined by maxillary incisor position.[21] Tweed's studies of facial balance led to the use of FMIA, the facial angle of his diagnostic triangle. He determined that procumbent mandibular incisors must be uprighted to make it possible for the maxillary incisors to be intruded as they are retracted (Fig. 9). Tweed's concept of uprighting the mandibular incisors before maxillary incisor movement to improve facial balance has proven valid.

Objective 2: Maxillary Anterior Tooth Position Must Be Controlled

The direction of movement of the maxillary incisors is imperative in the maintenance of anterior facial height. Control of these teeth as they are moved is critical if facial balance is an objective (Fig. 9). For most patients with moderate to excessive anterior facial height, the maxillary incisor must be intruded as it is retracted. Third order (torque)

Fig. 25. Posttreatment facial photographs from patient 3.

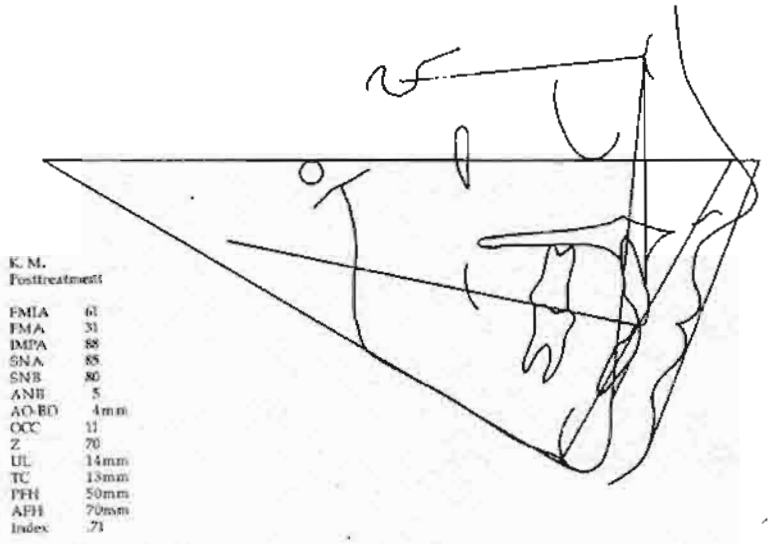


Fig. 26. Posttreatment cephalogram tracing from patient 3.

control must be carefully monitored as this movement is being accomplished.

Objective 3: Posterior Vertical Dimension Control

Posterior vertical control has a direct relationship to the mechanical force systems used. To control the vertical dimension, vertical as well as rotational control of the palatal plane, the occlusal plane, and the mandibular plane is essential (Fig. 10). If the posterior vertical dimension is not controlled—for instance, if molars are extruded—point B will drop down and back. Any horizontal mandibular growth that occurs cannot be used to advantage because the mandibular rotation is downward and backward (Fig. 11), not downward and forward (Fig. 12). As a result, anterior facial height will become lengthened and the development of harmony and balance of the lower face will be disrupted.

Fulfillment of these objectives gives the patient with a moderate to high FMA a much greater opportunity to have improvement in facial balance as a result of orthodontic treatment. This improved balance is directly related to the improvement in the horizontal spatial relationship of the mandible to the maxilla that can occur during orthodontic treatment.[22-25] This favorable spatial-relationship change of the mandible during and after active mechanotherapy is essential to the improvement of facial balance, especially for growing patients and even more so for those with Class II malocclusion.

CASE REPORTS

To illustrate these three concepts important in the successful treatment of the patient with a moderate to high "angle" skeletal pattern, the pretreatment and posttreatment facial photographs and cephalogram tracings of

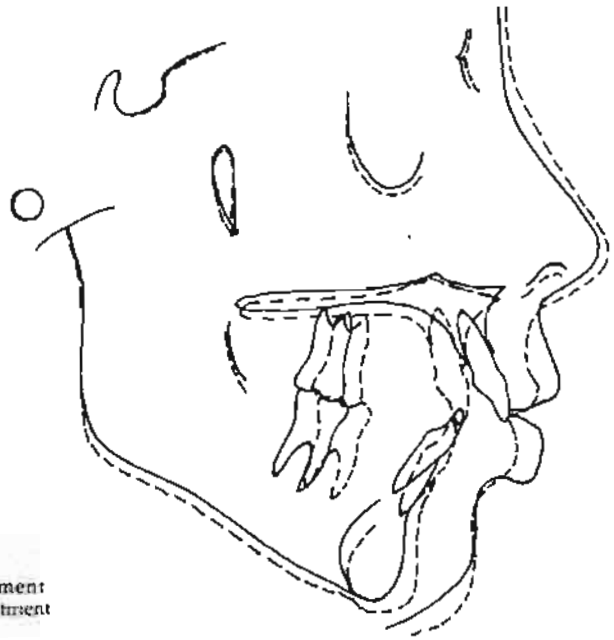


Fig. 27. Pretreatment/posttreatment tracing superimpositions from patient 3.

three patients with different malocclusions will be used. Diagnosis in all three was achieved with the Differential Diagnostic Analysis System[26] and Merrifield's "dimensions of the dentition" concept.[27] Treatment of these patients was accomplished with Merrifield Directional Force Systems,[28,29] which use directionally controlled precision archwire manipulation and extraoral headgear force. Facial balance was quantified with the use of the Z angle.

Patient 1: Angle Class I Malocclusion; Four First Premolars Removed

The facial photographs (Fig. 13) and pretreatment cephalogram tracing (Fig. 14) of this patient illustrate a facial imbalance created by a bialveolar protrusion of the teeth. The Z angle is a low 49°, and the profile line is very much in front of the nose. Posttreatment facial photographs (Fig. 15) confirm improved facial balance. During treatment, the mandibular incisors were uprighted from 101° to 80° (Fig. 16). The vertical dimension was maintained. Point A has been moved distally from an SNA of 87° to an SNA of 84°. The superimposition tracings (Fig. 17) illustrate a downward and forward change of the mandible relative to the maxilla. The facial height index of Horn,[30] which improved from 0.68 to 0.71, is an indicator of vertical control and the favorable skeletal response to orthodontic mechanotherapy. The three objectives previously described—uprighting of mandibular incisors, control of maxillary incisor position, and control of the posterior vertical dimension—were used in this patient's treatment. Quantification of the facial balance improvement is the Z-angle increase from 49° to 77°. The posttreatment profile line now lies midnose.

Patient 2: Angle Class II Malocclusion; Four First Premolars Removed

The second patient has a Class II malocclusion with a high FMA. The protrusive convex facial pattern is evident (Fig. 18). The pretreatment cephalogram tracing (Fig. 19) confirms the poor skeletal pattern. The FMA of 38°, the ANB of 7°, and the Z-angle of only 56° make correction of the malocclusion difficult. After the removal of maxillary and mandibular first premolars, the patient was treated with vertical control and mandibular incisor uprighting as primary treatment objectives. The posttreatment facial photographs (Fig. 20) illustrate pleasing balance and harmony. The facial convexity has been reduced, and there is a nice curvature of the lips. The FMA was reduced to 35° (Fig. 21), and mandibular incisors were uprighted from 94° to 75° (the mandibular incisors had to be overly uprighted to compensate for the high FMA). The Z-angle is a pleasing 75°. The superimpositions (Fig. 22) illustrate mandibular incisor uprighting, maxillary incisor positioning, and vertical control. These three keys were essential to the improved facial balance and harmony of this high-angle patient.

Patient 3: Angle Class II Malocclusion (Severe): Four First Premolars, Maxillary First Molars, and Mandibular Third Molars Extracted

This patient presented with an even more complex malocclusion and poor facial balance (Fig. 23). Procumbent mandibular incisors, an Angle Class II dental relationship, an FMA of 32°, and a very protrusive relationship of the maxilla to cranial base (confirmed by an SNA of 90° and an ANB of 13°) suggest a malocclusion difficult

to resolve (Fig. 24). The malocclusion was corrected with a nonsurgical, orthodontics-only approach. After a year of treatment following first premolar removal, the maxillary first molars were extracted to create space for continued maxillary incisor and anterior segment retraction, as well as mesial movement of the maxillary second molars into a Class I relationship with the mandibular first molars. The posttreatment facial photographs (Fig. 25) exhibit a lack of mentalis strain and the harmonious relationship of facial soft tissue. The posttreatment cephalogram tracing (Fig. 26) illustrates control of mandibular incisor position, distal movement of point A as a result of intrusion and retraction of the maxillary anterior teeth, and vertical control in the molar region. Superimpositions (Fig. 27) illustrate favorable mandibular spatial change in a downward and forward direction. The facial height index improved from 0.68 to 0.71, and the Z-angle improved from 55° to 70°.

CONCLUSIONS

The posttreatment facial photographs of these three moderate- to high-FMA patients illustrate the fact that facial balance and harmony can be achieved through adherence to three basic treatment concepts: (1) uprighting mandibular incisors, (2) control of maxillary incisor position, and (3) posterior vertical and rotational control of the palatal, occlusal, and mandibular planes. As the FMA becomes steeper, adherence to these three treatment concepts becomes ever more important if facial balance and harmony are to be achieved through orthodontic mechanotherapy.

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