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Comprehensive Phase I Treatment in the Middle Mixed Dentition

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The intent of this article is to open the minds of orthodontists regarding the effectiveness of mixed-dentition treatment. I do not wish to imply that mixed-dentition treatment (Phase I) can entirely eliminate the need for permanent-dentition treatment (Phase II), for extraction of permanent teeth, or for orthognathic surgery. I do maintain, however, that the more comprehensive the mixed-dentition treatment, the less need there will be for second-phase treatment, extractions, or surgery.

The purpose of Phase I treatment is to intercept any conditions that may negatively influence growth, development, and tooth eruption. Alveolar size and form should be encouraged to develop, within genetic potential, to accommodate all the permanent teeth. The maxillary and mandibular basal bone tooth-support systems should be encouraged to develop in all planes to produce a proper skeletal and dental Class I relationship.

Dental and facial formation is most effectively influenced during the formative years, when skeletal response is optimal.1-4 Since ossification of the skeletal sutures begins with the eruption of the permanent teeth and increases geometrically as eruption concludes, the ability to influence skeletal morphology diminishes drastically after all permanent teeth have erupted.5 For maximum stability, therefore, bony change should be initiated as early as possible. The ligament attachments of teeth to bone can also be altered with a more stable prognosis in the mixed dentition than if maturation is allowed to occur before tooth movement is attempted.6

Although some orthopedic treatment may be indicated in the primary dentition, the effectiveness of such treatment is extremely limited. Typically, the problem will not have expressed itself sufficiently at such a young age to warrant fixed appliances and the accompanying demands on patient cooperation.

Reasons for Two-Phase Treatment

- *1. Correct the problem when the response of hard and soft tissues is optimal .7* The old saying, "An ounce of prevention is worth a pound of cure", is certainly applicable to Phase I treatment.
- *2. Allow the orthodontist to delay the second phase of treatment until the second molars have erupted, providing the ideal conditions for the best possible end result.3* A skeletal Class II or III can seldom be totally corrected without including the second molars in the treatment. Without a first phase, however, the practitioner may feel compelled by the patient or parents to initiate single-phase treatment too early, and may use up the estimated treatment time prior to the eruption of the second molars. Treatment may then be discontinued too soon because of pressure from the patient or parents.
- *3. Prevent the orthodontist from relying on cephalometric analysis as the primary source of the treatment plan.* Tracings can still be useful, but two-phase treatment allows the patient to be observed through the first phase and into the second before such significant decisions as extractions or orthognathic surgery have to be made.8
- *4. Reduce the percentage of patients requiring extraction of permanent teeth.* If, after comprehensive Phase I treatment, extractions are still necessary to establish a healthy, functional, and esthetic result, the decision as to which teeth to extract will be more obvious. If removal of bicuspids would leave too much space, extraction of maxillary second molars and mandibular third molars might be a more esthetic solution.9-12
- *5. Reduce the need for surgical correction of skeletal deformities.* Even if orthognathic surgery is still required after Phase I, the degree of correction needed will be reduced.

- *6. Prevent the development of a dual bite.* The first phase of treatment will interrupt any compensatory posturing of the mandible during tooth eruption,7 thus avoiding the possible surprise of significantly more skeletal discrepancy than was originally diagnosed.
- *7. Increase the airway space.* This can alleviate breathing difficulties associated with allergies.
- *8. Correct periodontal problems due to dentoalveolar malformation before permanent developmental damage can occur. 13*
- *9. Produce a more stable long-term result. 14* Anything that improves the skeletal harmony in a growing patient will reduce the tendency for relapse. The longer the original skeletal morphology and the tooth attachments to that morphology remain, the greater the tendency will be to return to that original morphology after changes have been made.5
- *10. Initiate treatment when patients are most motivated.* Younger children are more likely to be receptive and cooperative.7
- *11. Allay parental concerns about sociopsychological problems resulting from facial disfigurement.8* Parents and patients are usually receptive to the idea of Phase I treatment, and if properly educated during treatment and the resting period, will not resist a second phase.
- *12. Create an image of excellence and caring.* An orthodontist who can establish comprehensive two-phase treatment as the acceptable mode in the community will realize an increased demand for services.

10 Treatment Coordinates

There are 10 corrective aspects of comprehensive orthodontic treatment, which I call the "10 treatment coordinates". These can be used to check progress and completion of either phase of treatment, with the emphasis on skeletal correction in the first phase and on dental correction in the second. The objectives of the 10 treatment coordinates are to:

- 1. Correct rotations
- 2. Correct crowding and spacing
- 3. Align marginal ridges
- 4. Correct root parallelism and axial inclination (maxillary incisors to NS, IMPA)
- 5. Correct arch width (equilibrium with lips, cheeks, tongue)
- 6. Correct archform (square, tapering, ovoid)
- 7. Correct curve of Spee
- 8. Correct denture-to-basal-bone relationship (mandibular incisors to NP, maxillary incisors to NP)
- 9. Correct denture-to-denture relationship (interdigitation, CR/CO, overbite, overjet)
- 10. Correct basal-bone-to-basal-bone relationship (ANB)

Treatment Timing

The first phase should be long enough to align the teeth and influence skeletal morphology.15 A treatment time of 12-18 months allows the necessary changes to be made without burning out patients and parents and discouraging them from a later second phase of treatment. Many practitioners have found the best treatment period to be after the eruption of the permanent maxillary and mandibular incisors and first molars–generally between 6 and 8 years of age.3

The ideal Phase I treatment would eliminate the need for a Phase II. This is rarely possible, however, and patients and parents should always be advised that mixed-dentition treatment is the first part of a two-part process. Even if the first phase does not eliminate the second phase, it does not mean the first phase was unsuccessful.

Phase II should not be initiated until the mandibular second molars have erupted, or are expected to erupt in time to be included in the treatment. Leaving intact the original maloccluded relationship of the second molars to their supporting structures while changing the relationship of all the other teeth to their supporting structures and to one another can be a formula for relapse. The other teeth will tend to return to their original positions, utilizing the second molars as focal points from which to reorganize.

The second phase can be shortened by a comprehensive first phase, but the total time of Phase II cannot be established as definitely as that of Phase I. Completion of Phase II depends on the accomplishment of the 10 treatment coordinates.

Ensuring Success with Two-Phase Treatment

Many orthodontists reduce the fee for second-phase treatment because they do not believe the results achieved in the first phase were significant enough.16 On the other hand, parents sometimes become angry because they forget being informed of an additional fee for Phase II.

Here are some ways to turn the potential problems of two-phase treatment into opportunities and make it a win-win situation for all concerned:

- *1. Convince the patient and parents of the value of two phases of treatment by developing a thorough treatment plan that they can understand and appreciate.* Make up a brochure and review it with the patient and parents at the beginning and end of the first phase and when necessary during the resting period.17
- *2. Keep primary dentition patients on recall, and begin Phase I only after the permanent incisors and first permanent molars have erupted.* In other words, select the time when Phase I treatment can be most comprehensive and effective.
- *3. Limit the first phase to a standardized treatment time, such as 12, 15, or 18 months.* Correct all that can be corrected during that time as well as possible,2 then keep the patient on recall. Charge a first-phase fee that is fair to both the orthodontist and the patient.
- *4. Prescribe a simple bite orthotic appliance, to be worn at night only, for retention of the first-phase correction.* Do not use any appliances during the resting period that require adjustment and maintenance visits.
- *5. Allow a long enough resting period between phases to avoid burnout for all concerned.*
- *6. Take complete diagnostic records before initiating the first phase*. Take progress records as necessary at the end of the first phase and the beginning of the second phase, and final records at the end of the entire treatment.
- *7. Determine the treatment plan and timing for the second phase only after complete permanent eruption has occurred.*
- *8. Quote a fee for the second phase that reflects the true extent and time of treatment needed.* Do not compromise if the first phase did not accomplish a full correction.

The combined treatment time and fee of the two phases will probably exceed that of single-phase treatment, but so will the quality of the end result. It is not difficult for the parents and patient to realize the advantages of intercepting growth and development problems and avoiding retreatment as an adult. Still, the orthodontist must be prepared to establish an excellent result within the quoted Phase I treatment time.

Treatment Modality for Phase I

Mechanotherapy for Phase I treatment must have the following characteristics to be consistently successful:

- It must be relatively simple for the doctor and staff–in other words, it cannot depart significantly from standard office procedures.
- It must be easy and comfortable for the patient to use and maintain.
- It must be esthetically acceptable.
- It must not require undue patient responsibility.
- It must not be cost-prohibitive or require sophisticated laboratory fabrication.
- It must be capable of consistently producing the required results as described above.

The utility archwire, with a few simple modifications and additions, is the best appliance for routinely obtaining satisfactory Phase I treatment results. The archwire should be covered with bumper tubing, and the legs should be bent so that the bumper holds the cheeks away from the teeth. The tongue can then expand and influence bone morphology by inhibiting the labial muscles. Because the effect is similar to that of a functional appliance, I refer to the wire as a "functional utility archwire". It has the following capabilities:

- Intrusion of overerupted anterior teeth.
- Extrusion of undererupted anterior teeth.
- Uprighting and/or expansion of molars.
- Protraction or retraction of maxillary and mandibular anterior teeth.
- Distalization of first molars to increase arch length.
- Rotation of maxillary first molars.
- Positioning of first molars to enhance anchorage.
- Inhibition of excess vertical development of the alveolar processes.

Auxiliaries that work well with functional utility archwires include:

- Intraoral Class II or Class III corrective forces.
- Palatal expansion appliances.
- Extraoral forces (headgear).
- Habit-inhibiting appliances for the tongue and/or fingers.

The key to success with a functional utility archwire is to sequence the archwires properly until the bracket slots can receive a full orthopedic-size stainless steel wire. The archwire sizes shown in this article are for .022" bracket slots, but the appropriate smaller sizes can be substituted if .018" brackets are used.

The first challenge is to unravel the maxillary and mandibular incisors. Air-rotor stripping of the primary cuspids and first molars can usually provide enough space for this alignment.18 Stripping of interproximal enamel can be done without anesthesia using the smallest tapered cross-cut fissure bur and a high-speed, air-driven handpiece. In severely crowded cases, extraction of primary cuspids may be necessary.

It is difficult to find an initial archwire that is flexible enough to engage in the slot and yet large enough not to rotate freely. A sectional archwire with curved archform for the four incisors will rotate in the slots and create adverse effects on the archform.

I have solved these problems by using Ormco's Ni-Ti braided rectangular (Turbo) wire. I start with

an .017" X .025" Turbo sectional that has the ends covered with small balls of light-cured adhesive for patient comfort (Fig. 1). The next wires are an .021" X .025" Turbo sectional and an .021" X .025" TMA sectional. Having aligned the bracket slots, I then proceed to either an .016" X .022" or an .021" X .025" stainless steel functional utility archwire, depending on the treatment requirements (Fig. 2). Stainless steel is superior to an alloy for orthopedic purposes because it has the rigidity to resist distortion while accommodating the forces needed for orthopedic influence.

The .016" X .022" functional utility archwire should be used for all tooth movements, such as intrusion of anterior teeth and distal movement of molars, because the teeth will be less resistant to the lighter forces of the smaller wire.14 The .021" X .025" size can maintain the integrity of the archform when heavy orthopedic forces are used.19

Some other tips for success with these archwires:

- Use a lubricant on the archwire when threading on the bumper tubing.
- Crimp hooks to the anterior vertical legs of the maxillary archwire for attachment of intraoral corrective forces.
- Do not bond brackets to molars; they will not withstand the force of the appliance.
- Use molar anchorage and full-size archwires when preparing for orthopedic corrective forces.
- After intruding the incisors, remove the excess molar tipback from the wire to avoid overtipping the molars.
- Correct a deep bite before attempting Class II correction.
- Instruct patients to brush the tubing when they brush their teeth.

Fixed Force System for Skeletal Correction

Headgears and elastics have traditionally been used as force systems for correction of interarch discrepancies, but they have many drawbacks, the most important being a dependence on patient cooperation. Taking the responsibility out of the hands of the patient requires either surgery or a fixed force system. Surgery is certainly warranted if the discrepancy is severe, but the vast majority of problems are correctable without surgical intervention, especially in growing patients. In cases where the desired results cannot be accomplished with headgears and elastics, I have found that a fixed force system such as Saif springs works well if used properly (Fig. 3).

I have had more than 20 years of success with these springs, which are available in either 7mm or 10mm lengths. I find that the 10mm spring, extended from the second molar to the cuspid, provides the optimal horizontal force for anteroposterior correction.

The initial change is primarily dental, expressed by a maximum movement of each denture within alveolar bone. The prolonged, continuous force then produces a skeletal response similar to that seen with a functional appliance.6 Both changes will tend to relapse and, therefore, need slight overcorrection and stabilization in the new environment for a long enough period to allow tissue adaptation. Stability can be tested by removing the forces for an observation period of around four weeks.

The prerequisites for successful treatment with Saif springs are:

- Prior correction of deep overbite.
- Stabilization of each arch with large rectangular archwires.
- Direction of force application as horizontal as possible.

- Sufficient resistant torque in the appliance.
- Perfect fit and cementation of molar bands.
- Proper placement of hooks for spring attachment.

If the patient is seen frequently – about every two weeks – a significant Class II relationship can be corrected in one to three months. Most patients accept the fixed springs reluctantly, but after getting used to them, prefer them to the aggravation of elastics, especially after they see progress toward completion of treatment. Sometimes a sudden change in cooperation with elastic wear occurs after a discussion regarding the possible need for Saif springs.

Placement of right and left springs takes about five minutes. The procedure is as follows:

- 1. During mixed-dentition treatment, while using a functional utility archwire, simply crimp a hook onto the anterior vertical leg of the wire. With full fixed appliances, make an offset bend in the maxillary archwire, between the cuspid and the lateral incisor, where the hook is to be placed. This will prevent the crimpable hook from sliding on the archwire and opening spaces.
- 2. Offset the eyelet end of the spring so that it points perpendicular to the spring and can slip easily over the molar hook (Fig. 4).
- 3. Close the molar hook so the eyelet will not slip off.
- 4. Activate the spring 2-3mm, and cut off the excess leader coil.
- 5. After attaching the leader over the anterior hook, close both leader and hook so they will not come apart.

Case Reports

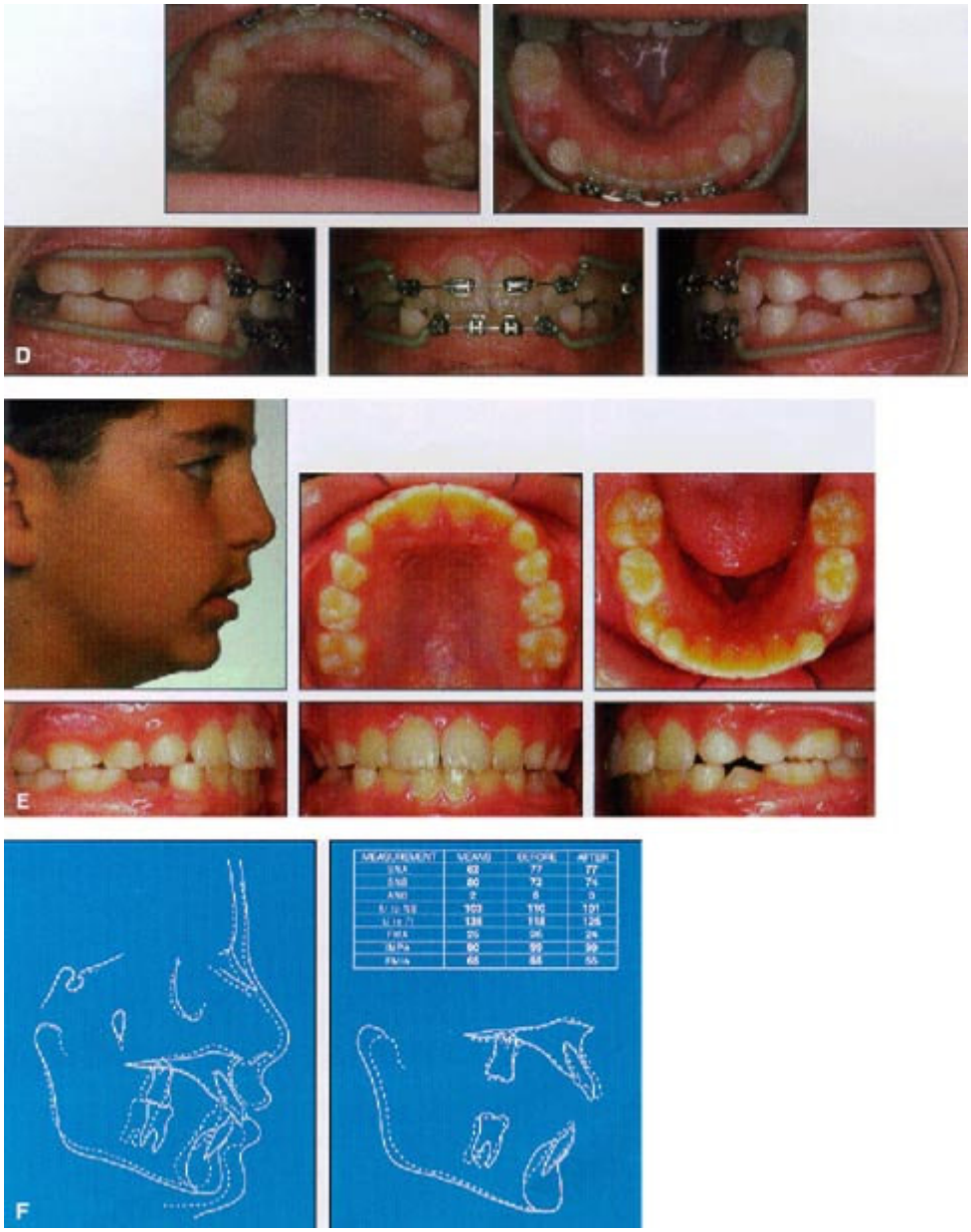
I have studied two-phase treatment in 72 cases. The three presented here represent three different biomechanical challenges: average, high, and low Frankfort mandibular angles (FMA). Theoretically, a case with an average FMA (25°) should be the least complex to treat.

At the time I treated these cases, I felt a full-size .021" X .025" archwire would prevent undesirable proclination of the mandibular incisors. I have not changed this opinion, but I now use a bracket with -6° of torque if excessive proclination would result from the use of orthopedic forces. This can avoid some round-tripping of the mandibular incisors.

The Phase I treatment in these three cases made it possible to achieve an excellent correction, with a full arch and facial balance, in Phase II.

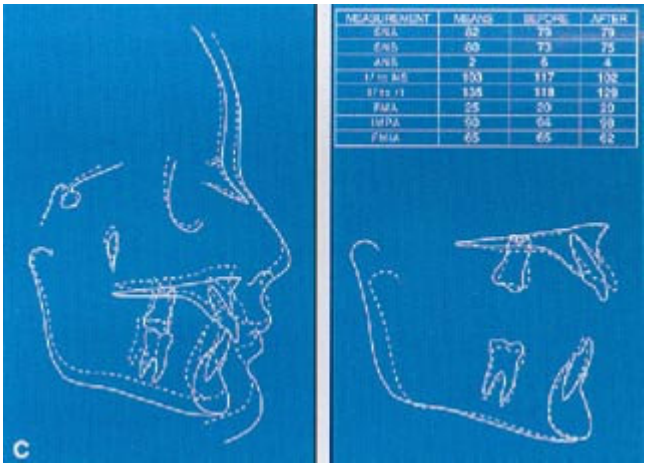
Case 1 Patient with average FMA treated in middle mixed dentition. A. Before treatment. B.

After three months of anterior alignment with .017" X .025" Turbo sectional and maxillary expansion. C. Six months later, showing correction in arch width, arch length, and overjet with functional utility archwires.



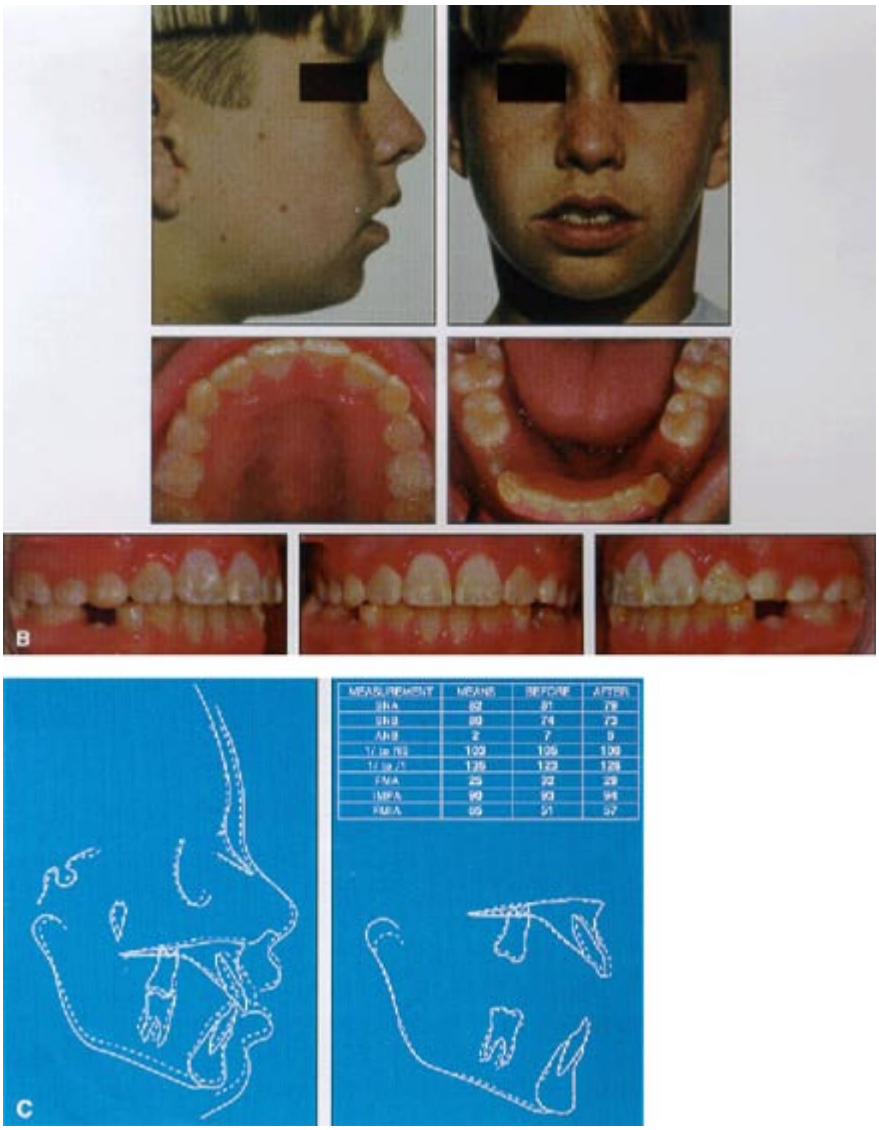
Case 1 (cont.) D. Overjet correction with six months of Class II elastics and two months of Saif springs. E. After 18 months of Phase I treatment. Clockwise rotation of incisors will be corrected in Phase II. F. Superimposition of cephalometric tracings before and after Phase I.

Case 2 Patient with low FMA treated in middle mixed dentition. A. Before treatment. B. After 18 months of Phase I treatment with functional utility archwires, supplemented by Class II elastics for five months.



Case 2 (cont.) C. Superimposition of cephalometric tracing before and after Phase I.

Case 3 Patient with high FMA treated in middle mixed dentition. A. Before treatment. Gingival condition was not worsened by presence of appliances and should improve after treatment.



Case 3 (cont.) B. After 18 months of Phase I treatment with functional utility archwires, supplemented by maxillary expander (six months), high-pull headgear (four months), and Class II elastics (two months). C. Superimposition of cephalometric tracings before and after Phase I.

The Bite Orthotic and Stability of Results

Skeletal corrections made in the mixed dentition should be retained with a bite orthotic made of high-impact plastic, rather than a conventional retainer (Fig. 5). The orthotic should be fabricated so that all the incisors and first permanent molars seat into individual indentations.20 This will hold the mandible in its corrected relationship to the maxilla until all hard and soft tissues have adjusted to the correction.

The bite orthotic should be worn for two hours in the evening and while sleeping during the entire resting period (at least six months) while waiting for complete permanent eruption.

It is logical to expect the results of two-phase treatment to be more stable than the results of single-phase treatment, because Phase I treatment prevents the complete development of dentofacial

problems.8 The amount of correction needed to normalize the disharmony in the second phase, and therefore the tendency for relapse, is thus reduced.

Bodily movement of teeth over significant distances, which is required to correct skeletal Class II discrepancies, normally stretches the ligaments attaching teeth to bone. With continued pressure, bone remodeling will eventually occur–first expressed as a bending of bone.5 The greater the amount of distortion or bending, the more precise and lengthy retention must be to prevent relapse. If the dentofacial changes are retained long enough for bone remodeling to conclude, then the relapse tendency will be negated.

Avoidance of relapse does not guarantee stability. An orthodontically created dentofacial relationship is subject to all the forces affecting the stomatognathic system–primarily from the muscles of the head and neck. If a denture is moved into a position within the enveloping muscles of the face, but is not in balance with all the forces of those muscles, it will be unstable and subject to change.

Conventional analysis and treatment plans are predicated on a stable position of the mandibular incisors. However, about half of these cases will undergo an unacceptable degree of post-treatment change, and it is impossible to predict in advance which cases these will be. Two solutions seem obvious: minimize the degree of developing dentofacial discrepancy with comprehensive Phase I treatment, and permanently retain all orthodontically treated patients. Two-phase treatment allows the plan for Phase II to be based on facial esthetics and the position of the *maxillary* incisors, while permanent retention ensures stability.

After the first phase of treatment, the bite orthotic can maintain maxillary and mandibular anterior tooth alignment, arch length, arch width, and skeletal correction–in other words, most of the 10 treatment coordinates. Whether the resting period lasts a few months or a few years, the bite orthotic reduces the extent of second-phase treatment, thus minimizing instability and relapse.

All patients should be permanently retained after second-phase treatment.21 One effective combination is a lower fixed cuspid-to-cuspid bonded retainer and an upper clear molded retainer, worn only at night. Until we can assure our patients of a stable treatment result without retainers, we have an obligation to provide permanent retention. Placement of permanent retainers may require time and effort, but the reward will be a reduction in retention appointments and the satisfaction of knowing the result will be stable. □

FIGURES

Fig. 1 Initial sectional archwires.

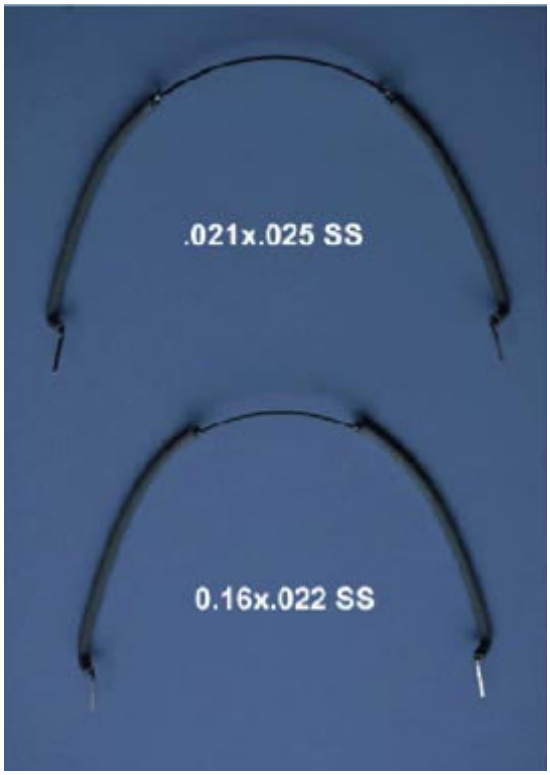


Fig. 2 Stainless steel functional utility archwires.

Fig. 3 Saif springs attached to functional utility archwires.

Fig. 4 Placement of Saif spring.

Fig. 5 Plastic bite orthotic used for retention of Phase I results.

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FOOTNOTES

1 Ni-Ti: Ormco, 1717 W. Collins Ave., Orange, CA 92667. TMA is a registered trademark.

2 TMA: Ormco, 1717 W. Collins Ave., Orange, CA 92667. TMA is a registered trademark.

3 Saif springs: Pacific Coast Manufacturing Inc., 18506 142nd Ave., N.E., Woodinville, WA 98072.

4 Bite orthotic: Allesee Orthodontic Appliances, 13931 Spring St., P.O. Box 725, Sturtevant, WI 53177.