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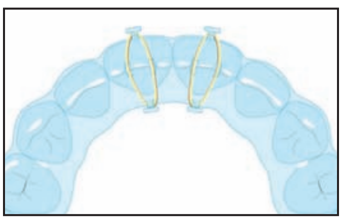
The Cover
Boston's John Hancock Tower is shown with Trinity Church in the foreground on this month's cover. © iStockphoto.com/Igorphoto



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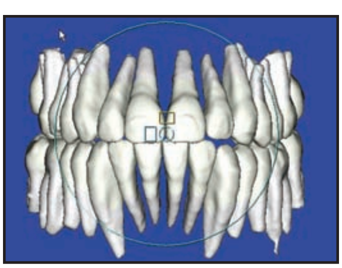

161 SureSmile System

DEPARTMENTS

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THE EDITOR'S CORNER

The Intelligence of Archwires

The ultimate goal in treating any orthodontic case is to provide the patient with optimal occlusion, function, and esthetics in a reasonable amount of time. Historically, the average orthodontic case has taken about two years, plus or minus a few months. Extraction cases seem to take a little longer; Class I nonextraction cases generally require the least amount of time, roughly 18 months in my practice. While maintaining or even improving the quality of treatment outcomes is always a goal for any clinician, reducing treatment time has for decades been a prime concern of orthodontists. First and foremost, shortening treatment is unquestionably in the patient's best interest. A number of studies have shown that longer treatment correlates with increased root resorption. In addition, as treatment extends beyond the expected time, the patient's compliance with dietary, hygiene, and other instructions tends to decline. The frequency of missed appointments also seems to increase the longer treatment drags on.

Prior to the advent of pre-programmed brackets, essentially all the "information" on 2nd- and 3rd-order movements had to be contained within the archwire. Learning to be an orthodontist involved extensive practice in bending wires to produce tipbacks, beauty bends, and customized torques. But since our best means of viewing the dentition in all three dimensions involved the tedious process of taking impressions and pouring models—no small feat when the appliance was already in place—the orthodontist generally had to rely on clinical judgment to make the required bends during treatment. Unless new plaster models were produced, it was impossible to see the full occlusion and proximal contacts of each tooth; lingual or cross-sectional views were out of the question. Based on what limited visual information was available, the doctor had to make decisions about how to bend the wire to produce the desired tooth movements. Excellent treatment results were certainly obtained, but the learning curve was steep.

Straight-Wire Orthodontics was an attempt to address the shortcomings of traditional edgewise mechanics by

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pre-programming the information on 1st-, 2nd-, and 3rd-order tooth movements into the brackets themselves. The "prescription" of each preadjusted appliance—essentially a standardized sequence of in-outs, tips, and torques—was based on the developer's notion of what would be ideal for all patients. Customization was limited to slight variances in the prescription to accommodate extraction vs. nonextraction treatment plans or similar diagnostic parameters. In the end, however, to achieve optimal results, it was almost always necessary to bend the finishing wires, based on the same limited visual information as before. Preadjusted brackets undoubtedly represented a tremendous advance in clinical science, providing outstanding treatment results while achieving some reduction in treatment time, but there was still room for improvement.

Computer-generated, three-dimensional imaging of the dentition, both in and out of occlusion—the technology behind the Invisalign system—may have been the biggest leap forward in orthodontic diagnostic science during the 20th century. Utilizing a "destructive scan" of plaster models, this technology allowed the clinician to view the dentition from all aspects and to manipulate the images as needed to get a comprehensive view of the occlusion and to project treatment outcomes. Today, 3D imaging of live patients using cone-beam radiography has eliminated the need for intermediary plaster models entirely. The images are becoming more and more precise, and the day is fast approaching when we will be able to work up an accurate, detailed diagnosis and treatment plan from the images and information generated by just one cone-beam scanning session. The possibilities are mind-boggling.

In this issue of JCO, Dr. Randy Moles describes an orthodontic technology that combines the advantages of digital imaging with the capabilities of new superelastic alloys. Using robotic devices with extremely precise tolerances, the SureSmile system brings us full circle by placing the information required for individual tooth movements back into the archwires. No specific appliance system is needed; straightwire or conventional brackets work equally well. Furthermore, intraoral scanning is coupled with cone-beam imaging to produce virtual images of the patient that allow complete digital articulation of the dentition, not only from all external aspects, but from micro-sliced cross-sections as well. This provides direct visualization of occlusal interferences that previously were detectable only through the use of articulating wax or paper. Without plaster models, the orthodontist can perform an incredibly exact diagnosis of the case, shifting the emphasis from chairside archwire manipulation to careful advance planning. Because of the three-dimensional visualization allowed by the imaging technology, any required finishing wires can be produced to the same precise standards. The end result, as Dr. Moles demonstrates, is that treatment times are greatly reduced.

To be sure, SureSmile's innovation has involved an amalgamation of currently available orthodontic technologies, but the key step was to turn from the smart bracket to the smart archwire. The elusive goal of reducing treatment time without sacrificing treatment results can now be achieved by any orthodontist, for virtually any patient. I urge you to read Dr. Moles's first-hand account of how the system can be incorporated into an existing practice.

RGK

Deep-Bite Correction Using a Clear Aligner and Intramaxillary Elastics

JAE HYUN PARK, DMD, MSD, MS, PHD
TAE WEON KIM, DDS, MSD, PHD

Deep bite can be corrected by intrusion of anterior teeth, extrusion of posterior teeth, or a combination of the two.[1] Anterior intrusion is often indicated in patients with excessive maxillary incisor display at rest or a deep mandibular curve of Spee associated with excessive lower anterior facial height. Such treatment can simplify control of the vertical dimension and allow forward rotation of the mandible, thus facilitating Class II correction.[2]

As demonstrated in this article, a Suspender Clear Aligner can be used with intramaxillary elastics to achieve minor intrusion during aligner treatment or to correct relapse during the retention phase of deep-bite treatment.

Appliance Fabrication and Activation

To fabricate a Clear Aligner for correction of deep bite, first take an impression for a working cast. Form an .030" plastic sheet* over the cast using a pressure molding machine** or a vacuum machine.***[3-5] Blocking out undercuts on the model before thermoforming allows more efficient intrusion of the target tooth (Fig. 1A). After the aligner has been fabricated, mark the locations of grooves for elastics with a pencil (Fig. 1B).

Use a 1mm-diameter fissure bur to make 1.5-2mm-deep channels or grooves at the marked locations (Fig. 2A). Finish the grooves with a laboratory knife, and check the depth with a ruler (Fig. 2B).

Mark labial and lingual hook positions on the aligner, gingival to each target tooth (Fig. 3A). Use Clear Aligner Pliers† or Hilliard Thermopliers*** to make projections in the plastic and convert them to hooks (Fig. 3B,C). Use Clear Aligner Pliers or ThermoAire Undercut Enhancing Pliers*** to improve the mechanical retention and thus the

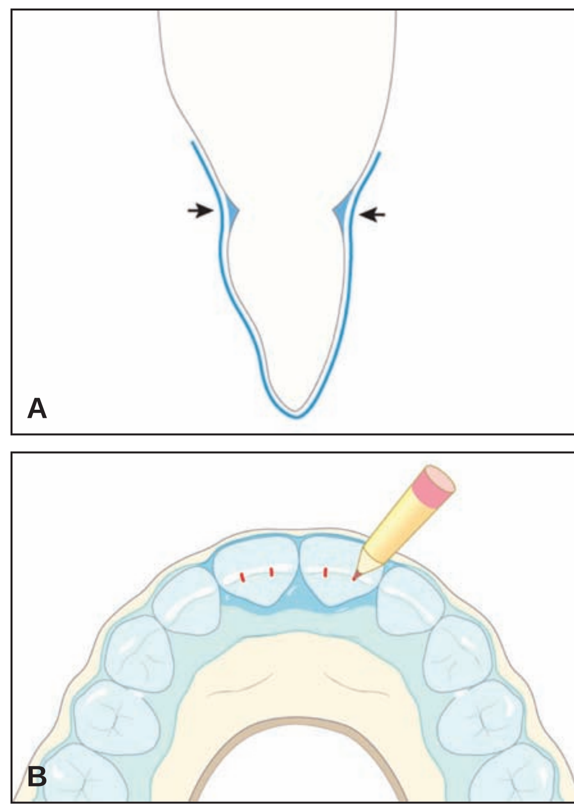

Fig. 1 A. Undercuts blocked out before thermoforming for more efficient intrusion of target tooth. B. Grooves for elastics marked on aligner with red pencil.

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†IV-Tech Co., Shinsa B/D 3F, 567-23, Shinsa-dong, Kangnam-gu, Seoul 135-891, Korea; www.ivtech.co.kr.

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Dr. Park

Dr. Kim

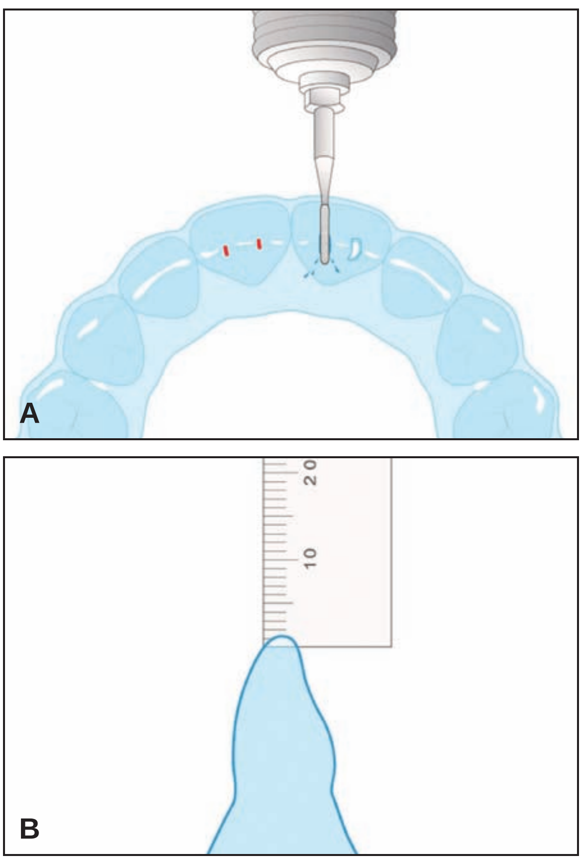

Fig. 2 A. 1mm-diameter fissure bur used to make grooves in aligner. B. Depth of grooves checked with ruler after finishing.

stability of the aligner (Fig. 4).

Engage ⅛", 4oz elastics‡ to the labial and lingual hooks over the target teeth (Fig. 5A). Alternatively, elastic hooks can be placed between two adjacent teeth to be intruded simultaneously (Fig. 5B). This method is recommended in the mandibu-

‡3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016; www.3Munitek.com.

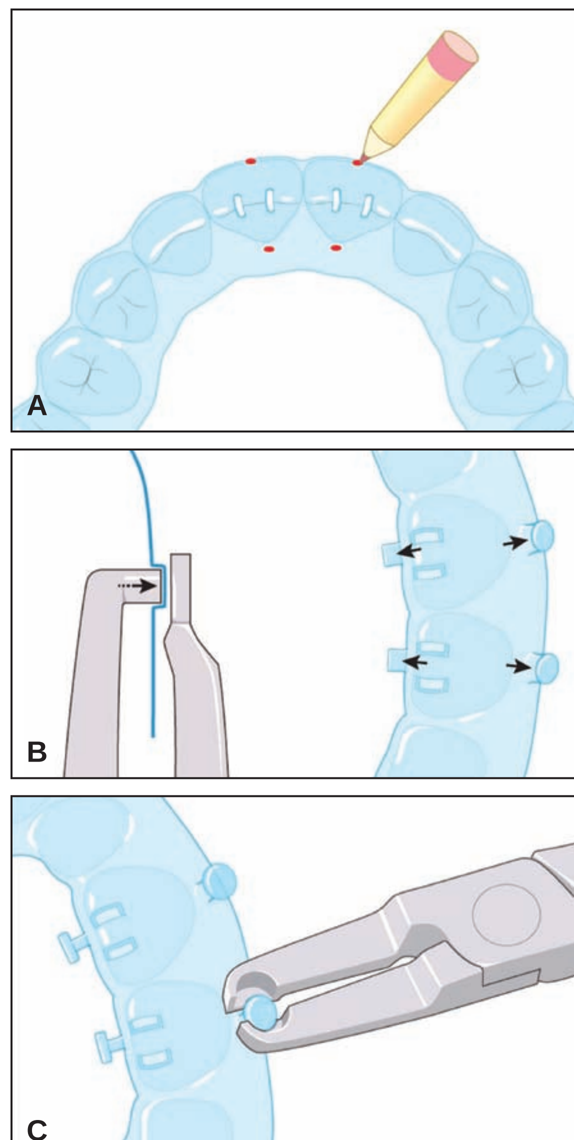

Fig. 3 A. Labial and lingual hook positions marked on aligner. B. Cylinder-forming plier used to make projections. C. Undercut-forming plier used to turn projections into hooks.

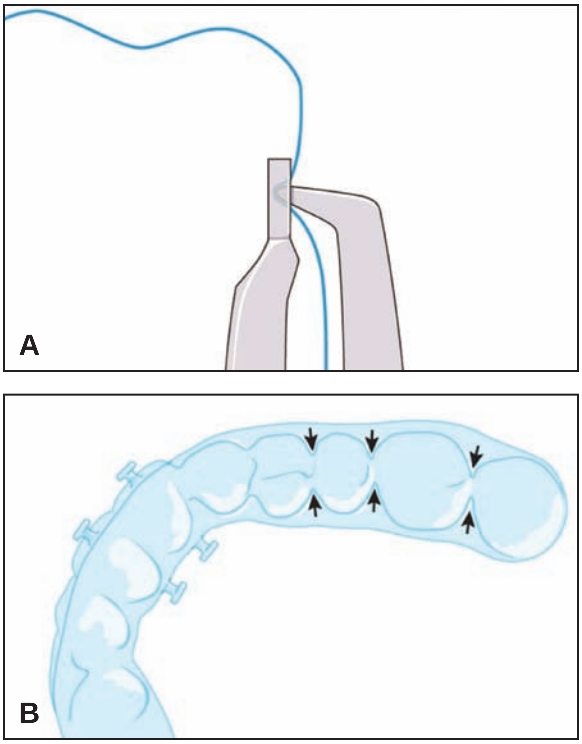

Fig. 4 A. Undercut-enhancing plier used to improve aligner retention. B. Interproximal locations of undercuts.

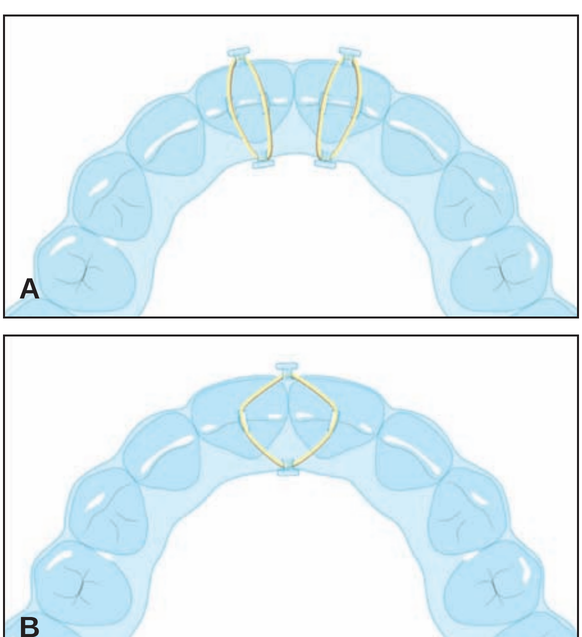

Fig. 5 A. Elastics attached to labial and lingual hooks over target teeth. B. Adjacent teeth engaged with single elastic, using interproximal hooks.

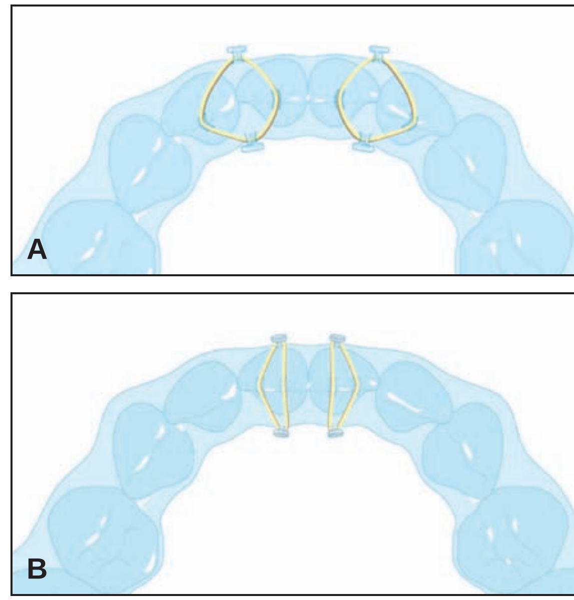

Fig. 6 A. Elastics attached to interproximal hooks over adjacent mandibular incisors. B. Because of small surface area, multiple grooves on individual mandibular incisors are not recommended.

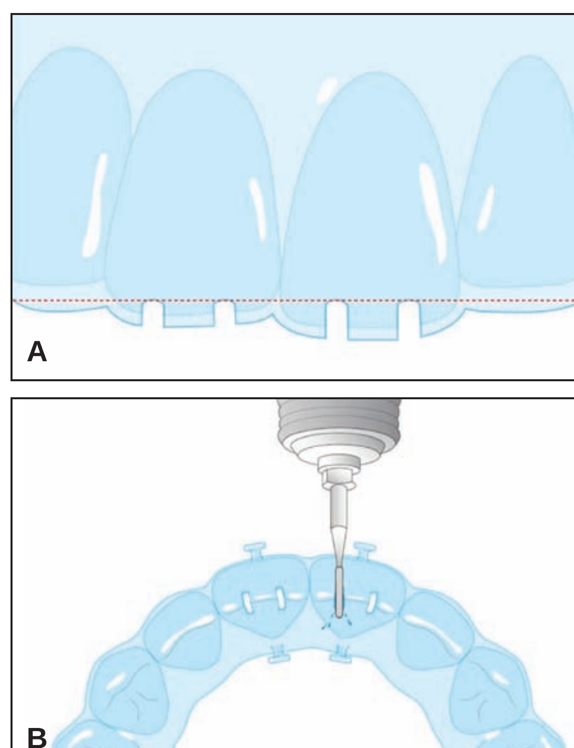

Fig. 7 A. Depth of groove determines amount of intrusion potential. B. Groove deepened for additional intrusion.

lar arch because of the small surface area available for grooves on individual incisors (Fig. 6).

If additional intrusion is desired, the groove can be deepened with the same fissure bur (Fig. 7). This procedure allows rapid intrusion with a single aligner, using chairside reactivation if necessary.

Case Report

A 29-year-old female presented with a Class I malocclusion and deep bite (Fig. 8A). She asked for treatment to be completed as quickly as possible, without conventional fixed appliances. Using the Suspender Clear Aligner (Fig. 8B), the deep

Fig. 8 A. 29-year-old female patient with Class I malocclusion and deep bite before treatment. B. During treatment with Suspender Clear Aligner. C. Bite opening after 10 weeks of treatment.

Fig. 9 A. Patient casts before treatment. B. Intrusion achieved in 10 weeks. C. Mandibular cast before treatment. D. Intrusion achieved in 10 weeks.

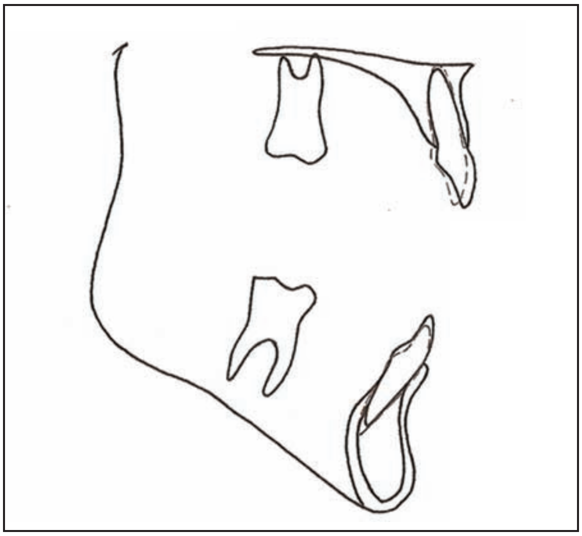

Fig. 10 Superimposition of pre- and post-treatment cephalometric tracings, showing maxillary and mandibular incisor intrusion.

bite was improved after 10 weeks of treatment (Fig. 8C).

To verify the amount of intrusion indicated by the casts (Fig. 9) and regional superimpositions (Fig. 10), the Clear Aligner Program† (CAP) was used to superimpose digital photographs of the pre- and post-treatment casts. The program can measure tooth movements in .1mm increments; in this case, the linear CAP measurements showed a 1.3mm intrusion of the maxillary central incisors and a 2.0mm intrusion of the mandibular incisors (Fig. 11). The Aligner Model Checker† (AMC) was used to measure torque changes between the pre- and post-treatment casts. After the casts are placed in the holder, the correct orientation plane should be established with a level. For this patient, the AMC showed a reduction in maxillary central incisor torque from 12° to 7°, but no change in mandibular central incisor torque (Fig. 12).

At the end of active treatment, .0175" Twistflex wire‡ retainers were bonded from canine to canine in both arches. New Clear Aligners were ordered as removable retainers, to be worn full-time for six months and then at night indefinitely. Follow-up records taken three years after the end of treatment showed good long-term stability (Fig. 13).

Discussion

Treatment of deep bite is controversial, especially when the patient exhibits a brachyfacial pattern. Schudy recommended extrusion of the

Fig. 11 Clear Aligner Program† showing intrusion of target teeth before treatment (black lines) and after treatment (red lines). A. 1.3mm intrusion of maxillary central incisors. B. 2.0mm intrusion of mandibular incisors.

premolars and molars to open the bite in nearly all cases.[6] On the other hand, Ricketts and colleagues advocated intrusion of the incisors, particularly the mandibular incisors, reporting an average intrusion of 3mm and post-treatment relapse of 1mm, for an expected net intrusion of 2mm.[7] If more than 2mm of mandibular incisor intrusion were required, however, the results would be compromised by unwanted mandibular incisor proclination or premolar extrusion.

Vertical anterior relapse is common after deep-bite correction. Stackler noted that this relapse is due to a combination of factors, including elongation of the mechanically depressed maxillary incisors and mesial tipping of the leveled posterior teeth.[8] Previous studies have suggested that axial inclinations of the incisors or the interincisal relationship at the end of active treatment may also be involved.[6,9] When all other relationships remain unchanged, anterior vertical overbite

†IV-Tech Co., Shinsa B/D 3F, 567-23, Shinsa-dong, Kangnam-gu, Seoul 135-891, Korea; www.ivtech.co.kr.

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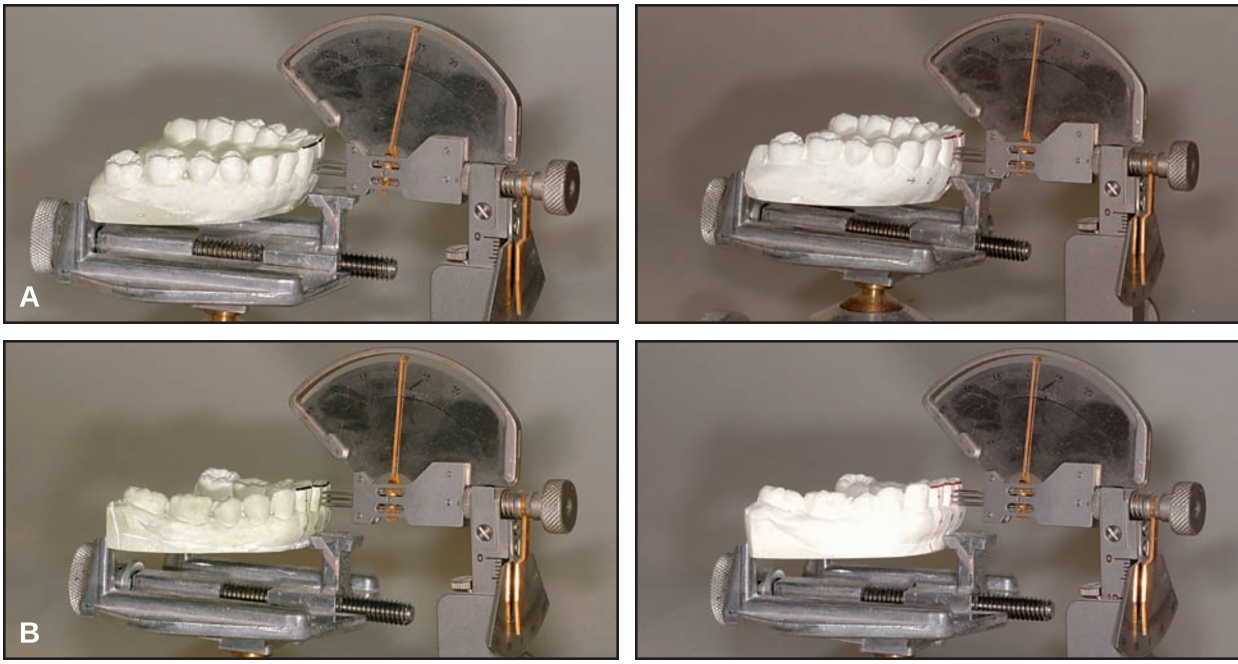

Fig. 12 Measurement of maxillary and mandibular incisor torque with Aligner Model Checker† and model holder. A. Torque change of –5° in maxillary central incisors. B. No change in mandibular incisors.

Fig. 13 Follow-up records taken three years after end of treatment.

decreases as the interincisal angle decreases. In our case, however, interproximal reduction was used along with maxillary central incisor intrusion to maintain the pretreatment overjet. This caused a reduction in maxillary central incisor torque and a slight increase in the interincisal angle. Interproximal reduction has also been recommended to reduce friction between contact points during the intrusion procedure.[10]

Conclusion

A Clear Aligner, in combination with intramaxillary elastics worn at least 17 hours per day, can achieve 1-2mm of intrusion in four to 10 weeks.[3-5] Therefore, this can be an effective treatment method in selected deep-bite patients. In particular, it is a good alternative to conventional fixed appliances for patients who want fast and esthetic treatment.

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Modified Hyrax Expander for Correction of Upper Midline Deviation

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CINZIA MASPERO, MD, DDS
DAVIDE FARRONATO, DDS, PHD
LUCIA GIANNINI, DDS

In a mixed-dentition patient with maxillary transverse deficiency, when a deciduous canine is lost prematurely, the permanent incisors may migrate toward the affected side, reducing or closing the space available for eruption of the permanent canine. Lateral displacement of the incisors also results in maxillary asymmetry and significant midline deviation. These problems can be corrected by adding a buccal arm to a Hyrax* rapid palatal expander.

The present article describes the use of such a modified Hyrax appliance.

Case Report

An 8-year-old female presented with a Class I malocclusion, a maxillary transverse deficiency, and a midline discrepancy due to the premature loss of the maxillary left deciduous canine (Fig. 1). Rapid palatal expansion was planned to increase the maxillary arch dimensions and correct the midline asymmetry. Molar bands were placed in the mouth, and an alginate impression was taken. The impression and molar bands were then sent to the laboratory for assembly of a modified Hyrax appliance.

Fig. 1 8-year-old female patient with Class I malocclusion, maxillary transverse deficiency, and midline discrepancy due to premature loss of deciduous left canine before treatment.

The appliance was fabricated with the following components: a stainless steel frame, the two molar bands, two palatal arms welded to the bands and extending to the mesial surfaces of the canines, a 9mm central jackscrew, and a buccal arm with a terminal loop extending from the molar band to the labial surface of the central incisor on the side opposite the maxillary midline deviation (Fig. 2).

The finished appliance was delivered as follows (Fig. 3):

1. Separators were placed three days before appliance insertion.
2. The appliance was tested in the mouth for proper fit.
3. The labial surface of the incisor to be bonded

*Registered trademark of Dentaurum, 10 Pheasant Run, Newtown, PA 18940; www.dentaurum.com.

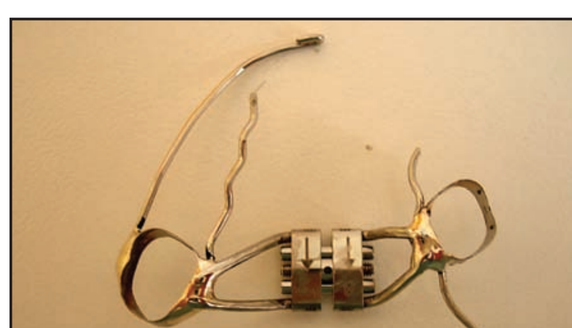

Fig. 2 Modified Hyrax* expander with buccal arm.

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Dr. Maspero


Dr. D. Farronato


Dr. Giannini

to the buccal arm of the appliance was etched and primed.
4. The appliance was cemented in place.
5. The terminal loop of the buccal arm was bonded to the incisor with composite.
6. The palatal and buccal arms of the appliance were correctly positioned and inclined.

The appliance was activated with a quarter-turn twice a day for 15 days. This generated about 2-3kg of force, producing .5mm of expansion per day. Thus, the total amount of expansion was about 7.5mm. The patient was seen once a week for two weeks (Fig. 4). After the palatal expansion was complete, a stainless steel ligature wire was tied in to deactivate the appliance. The expander was left passively in place to allow the results to stabilize and the contralateral incisors to drift into the space that had been opened (Fig. 5), a process that was expected to last four to six months (Fig. 6). The patient was scheduled for bonding of full fixed appliances to complete treatment.

Fig. 3 Example of appliance insertion before activation (different patient).

Discussion

The midline discrepancy created by lateral displacement of maxillary incisors after premature loss of a deciduous canine may cause anterior crowding, which can lead to secondary crowding in the mandibular arch. In addition, maxillary deficiency may restrict mandibular development in the sagittal or transverse dimension. Arch constriction should be treated as early as possible to promote normal function and proper tongue position; a narrow palate is associated with a low tongue position, which often leads to mouthbreathing.[1,2] Symmetry of the dental arches is critical to achieve maximum intercuspation, a functional occlusion, and stability, and to reduce the likelihood of TMJ dysfunction.

The modified Hyrax expander described here

Fig. 4 Patient during palatal expansion phase.

Fig. 5 Drifting of incisors into opened spaces after five months of passive retention.

Fig. 6 Patient after appliance removal.

can facilitate the correction of these problems without the need for extractions.[3-11] Increasing the arch length and improving the archform create extra space that can be concentrated in the canine area. The consolidation of the half-arch contralateral to the maxillary midline deviation allows optimal distribution of the space produced by the palatal expansion, permitting the displaced incisors to move into the available space and, in turn, allowing proper eruption of the permanent canine. Such a procedure can gain 7-9mm of space, enough to avoid problems with canine eruption that would require more complex treatment procedures. Moreover, a midline deviation of as much as 5-6mm can be resolved.

Use of the modified Hyrax expander with a buccal arm is an effective intervention that can reduce the duration of treatment with fixed appliances. The protocol can be adapted for each individual case. For patients allergic to nickel, the appliance can be fabricated with a pure titanium frame.

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THE CUTTING EDGE

(Editor's Note: This quarterly column is compiled by JCO Technology Editor Ronald Redmond. To help keep our readers on The Cutting Edge, Dr. Redmond will spotlight a particular area of orthodontic technology every three months. Your suggestions for future subjects or authors are welcome.)

This month's Cutting Edge column by Dr. Randy Moles tells the story of converging technologies that have spawned a major breakthrough in orthodontics. These technologies all have a common ancestry in the digital age.

SureSmile* incorporates intraoral scanning, cone-beam computed tomography, special-alloy archwires, and precision robotic wire bending, coupling these new technologies with the orthodontist's traditional, highly developed skill sets: diagnosis and treatment planning. It has always been the clinician's dream to produce the desired orthodontic results in the shortest possible time, and SureSmile is dedicated to that goal.

I believe you will find Dr. Moles's article educational, thought-provoking, and even inspirational. Please pay attention, however, when he says that there is a definite learning curve involved. Of course, a learning curve is inherent in practically any orthodontic discipline that is worth the effort; I believe that to be the case with SureSmile.

W. RONALD REDMOND, DDS, MS

Dr. Redmond

Dr. Moles

The SureSmile System in Orthodontic Practice

I have always been interested in new technology and its application to orthodontics. Over the years, that interest has led to my involvement in a number of orthodontic research teams, some aimed toward the elimination of wire bending because of its inherent inaccuracy. The "holy grail" of these research efforts was a system of straight wires that, in combination with precision bracket placement (possibly even customized brackets), could obtain perfect results in as few visits as possible. Therefore, I was intrigued by the SureSmile system when I first heard about it more than five years ago.

My Decision to Implement SureSmile

SureSmile's concept of focusing on the wire instead of the bracket to achieve ideal results seemed novel, but my initial bias toward the "perfect bracket" kept me from pursuing the technology. Moreover, the system as it was first introduced to me in the beta stage was just too cumbersome to bring into my busy practice. So I played the cautious observer for more than a year. The turning point came when one of the members of my orthodontic study club who had used the system said, "It really works!"

My decision to bring SureSmile into my practice was based on the idea that it would be a way to treat patients faster, in fewer visits. I was already getting what I considered to be good

*Registered trademark of OraMetrix, Inc., 2350 Campbell Creek Blvd. #400, Richardson, TX 75082; www.orametrix.com. Dr. Moles is a lecturer for OraMetrix.

Fig. 1 Intraoral scanning of bracketed teeth into SureSmile* system.

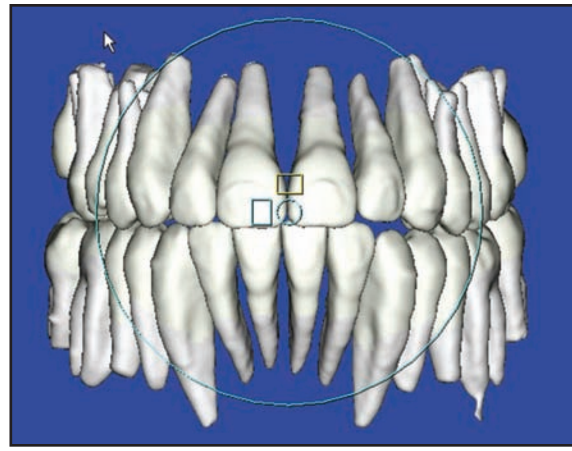


Fig. 2 Virtual teeth with anatomically correct roots from i-CAT*** three-dimensional scan.

results, so I was not convinced I would see a real benefit in terms of treatment quality. Of course, there was the issue of the cost of this sophisticated system in dollars, time, and energy. Because SureSmile was new and only a handful of orthodontists were using it, we would have to develop our own office procedures to make it work in our fast-paced environment. To that end, I set up a long staff meeting to explain the system to the team and review my rationale for acquiring it. I explained that new technologies were creating rapid change in the practice of orthodontics, and that I strongly believed the future success of our practice depended on embracing that change. We had been using Invisalign** for some time, but it had its limitations. I compared the various options for digital orthodontics, discussing the pros and cons of each, and we agreed that the SureSmile system would work best for us.

Our Integration Plan

Once the decision to introduce SureSmile had been made, we discussed at length how we could integrate it into the practice as seamlessly as possible. Four significant changes had to be made:

1. Obtaining the initial records and transferring them to the computer to create diagnostic models.
2. Scanning the bracketed teeth using the intraoral SureSmile scanner.
3. Building in clinician time for the virtual setup and wire order.
4. Using superelastic copper nickel titanium wires for treatment.

Initially, we had to scan our study models into the computer manually, using the SureSmile intraoral scanner. This took about 15 minutes per model set and required a tracking system. Fortunately, since we were already digital, it only required a few clicks to input the photographs and radiographs. With good tracking, this has proved to be no more difficult than obtaining traditional records.

The Learning Curve

Intraoral scanning was difficult for the first few months (Fig. 1); there is definitely a learning curve here. Our first scans took as long as 45 minutes. After a few months, that time had dropped to 20 minutes. But when SureSmile added support for i-CAT*** scans, we reduced the scanning time to around 20 seconds! We can use computed tomographic (CT) scanning in approximately 70% of

**Registered trademark of Align Technology, Inc., 881 Martin Ave., Santa Clara, CA 95050; www.aligntech.com.

***Registered trademark of Imaging Sciences International, Inc., 1910 N. Penn Road, Hatfield, PA 19440; www.imagingsciences.com.

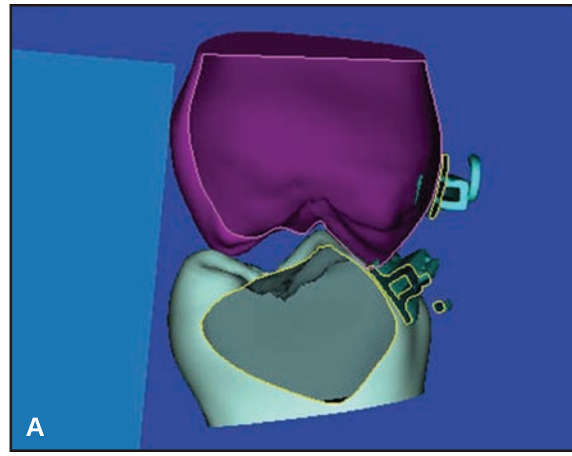
our patients. The other 30%, who have crowns or large fillings, are still scanned intraorally. Besides reducing chairtime, the shift to CT scans has greatly improved the quality of my results, because I can see and move not only the crowns, but also the roots of the teeth (Fig. 2). It is wonderful to have this additional perspective in treatment planning and detailing.

Most Class I nonextraction patients are scanned with the i-CAT at the initial bonding visit. Walking the patient down the hall for the scan adds only a few minutes to the appointment. For Class II, Class III, or extraction patients, because the archwires must be removed for scanning, we wait for a wire-change visit after they have progressed to Class I and the extraction spaces have nearly closed. If we placed the SureSmile wires earlier, the bends in the wires might interfere with sliding mechanics.

I had not anticipated how much SureSmile would change the treatment process. I was used to making treatment decisions on the fly at each patient visit. It was a lot like driving a car by looking in the rearview mirror, seeing what had happened, and then deciding what to do next. In contrast, with SureSmile, the desired movements are set up ahead of time. To have this kind of control and precision is exhilarating, but it does take some time to adjust to a new way of thinking. In particular, it required me to dedicate time to the planning process. I had to learn a fairly sophisticated software program and then be disciplined enough to think ahead. I have been pleasantly surprised to be rewarded by much shorter treatment times, more consistently excellent results, and less stress. I now spend about 20 minutes of total computer time on each patient. On the other hand, my time spent at the chair bending wires is literally zero!

My Findings

SureSmile allows the use of several different wires, including stainless steel and titanium niobium. But I find that copper nickel titanium is my workhorse. I can place it in fairly crowded dentitions, and it has all the 1st-, 2nd-, and 3rd-order



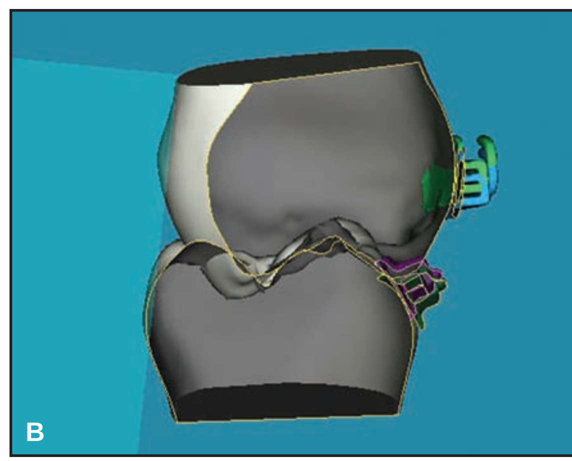


Fig. 3 Virtual teeth "sliced" to show interferences. A. Occlusal interference. B. Bracket interference.

bends to finish the case. If the teeth are really out of alignment, I can order a wire with the bends reduced by 50%, or by any percentage I desire, for easier placement. After that wire has been used, I can order and place a wire with 100% of the necessary corrective bends.

In my opinion, however, the major advantage of SureSmile is that it is a dynamic system, which means it is adjustable at any point during treatment. In my long career, I have found that perfection is rarely attainable, and unexpected problems inevitably crop up. For example, I may miss a small discrepancy in tooth position while checking the setup in the computer. Bone density, root shape,

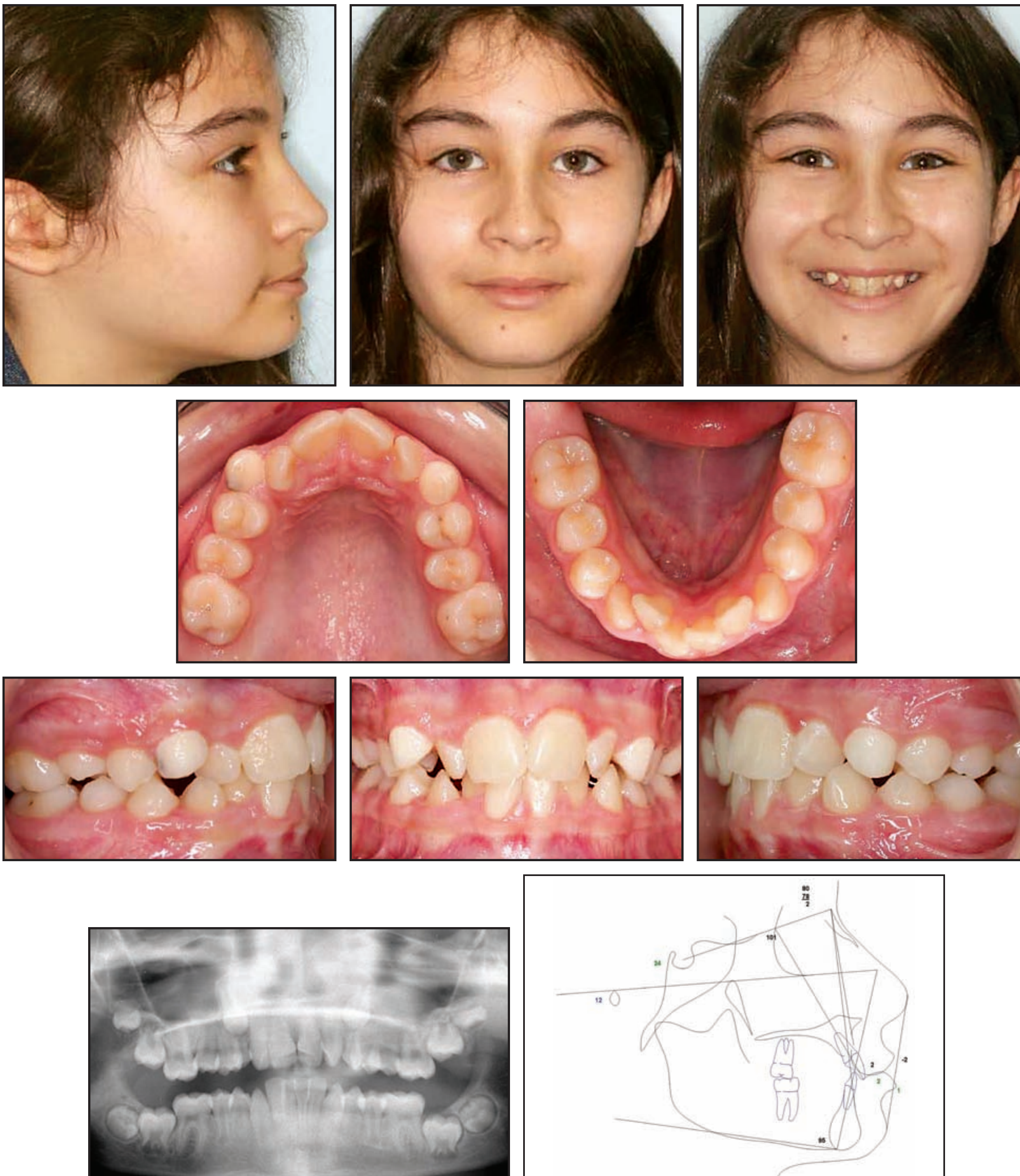


Fig. 4 Case 1. 11½-year-old female patient with Class I occlusion, severe crowding, lateral crossbites, and impacted maxillary canines before treatment.

or occlusal forces may prevent a tooth from moving exactly as I had planned. With SureSmile, I can go into the system, see the interferences (Fig. 3), make the required adjustments in the virtual world, and have a corrected wire within two weeks. Because the new wires include all the original bends, I am always building on my previous work. This gives me a degree of control that is not possible with manual wire bending. The predictability of the process greatly reduces my stress. Although the first SureSmile wire usually gets me close to the desired result, I often order a second wire to make minor corrections.

When I first started using SureSmile, I did little to modify my mechanics. The beauty of the system is that it is "nondenominational", by which

TABLE 1
CASE 1 CEPHALOMETRIC DATA

	Norm	Pre-treatment	Post-Treatment
SNA	82.0°	80.5°	78.9°
SNB	80.9°	78.0°	78.8°
SN-GoGn	32.9°	24.5°	24.5°
FMA (MP-FH)	24.5°	20.6°	20.4°
ANB	1.6°	2.4°	0.1°
U1-NA	4.3mm	2.3°	5.8°
U1-SN	102.6°	101.5°	107.4°
L1-NB	4.0mm	1.9mm	2.5mm
L1-MP	95.0°	94.8°	88.6°

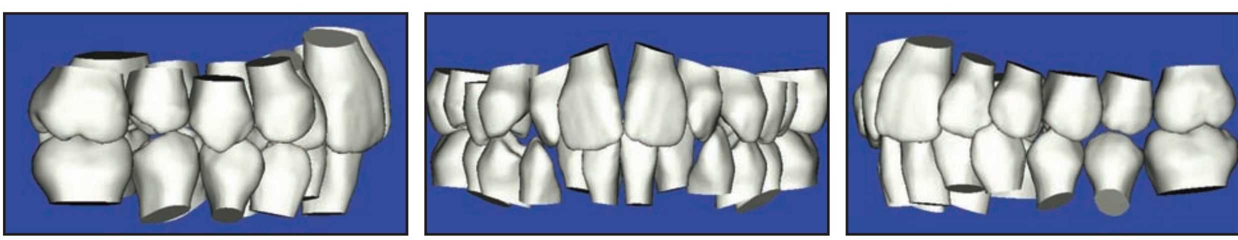


Fig. 5 Case 1. Pretreatment virtual diagnostic models. (Cases pictured in this article were treated before i-CAT compatibility allowed incorporation of roots in diagnostic images.)

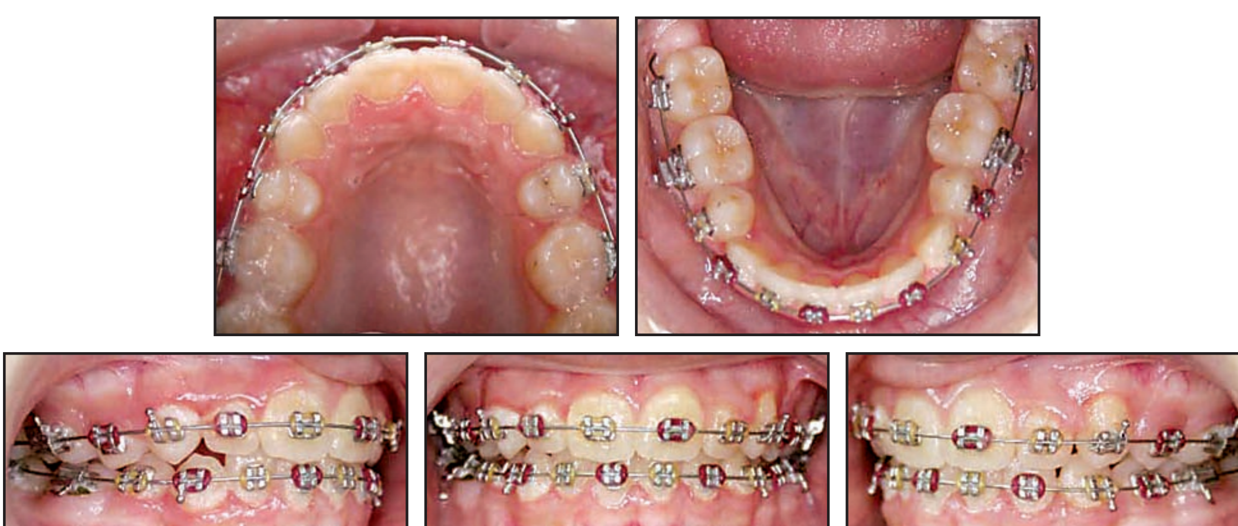


Fig. 6 Case 1. After 13 months of treatment, with extraction spaces closed and patient ready for SureSmile scanning to create therapeutic model.

I mean it can be used with any bracket system. I just continued doing everything pretty much the same way and used SureSmile only for finishing wires. As I became more comfortable with the system, I began placing the wires earlier and earlier in treatment. This has greatly reduced my treatment times: in more than 500 finished cases, the average treatment time is now 13.1 months.

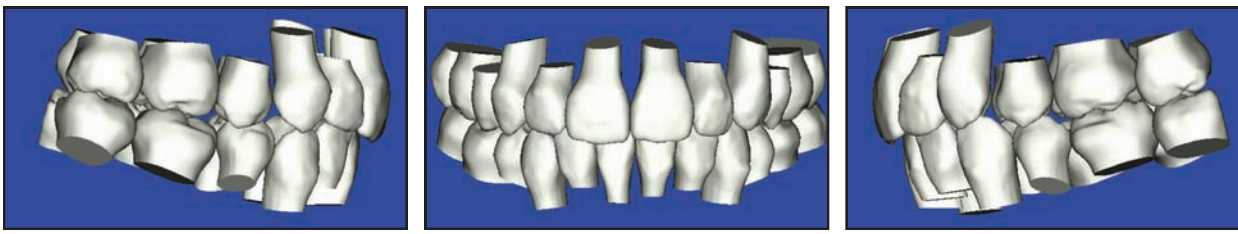


Fig. 7 Case 1. Therapeutic model for setup.

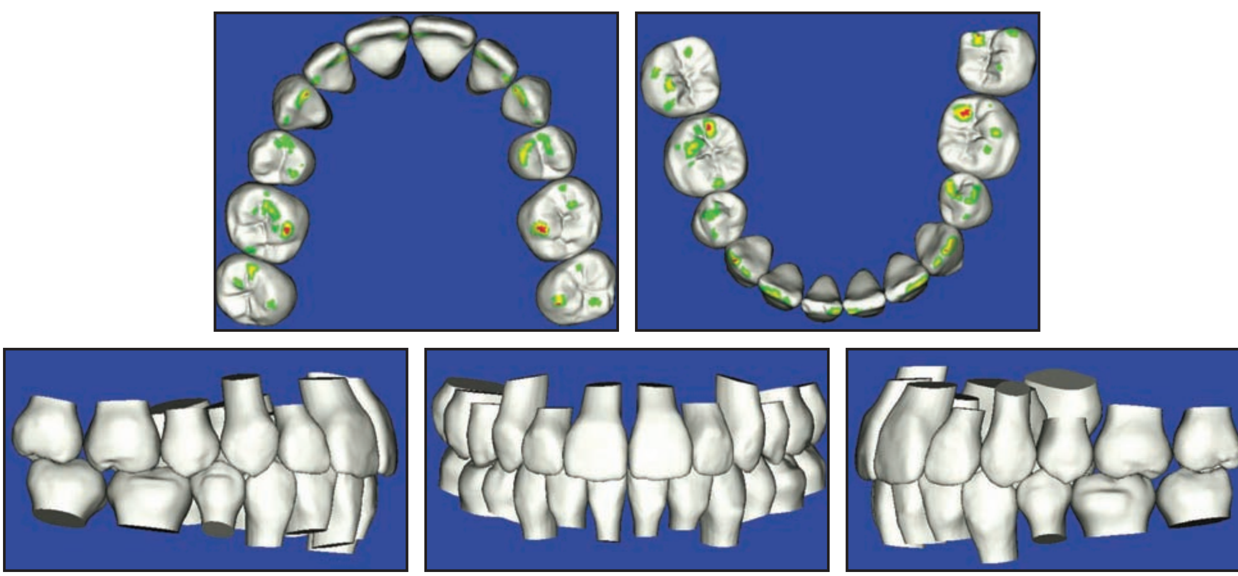


Fig. 8 Case 1. Virtual setup based on clinician's prescription and detailing.

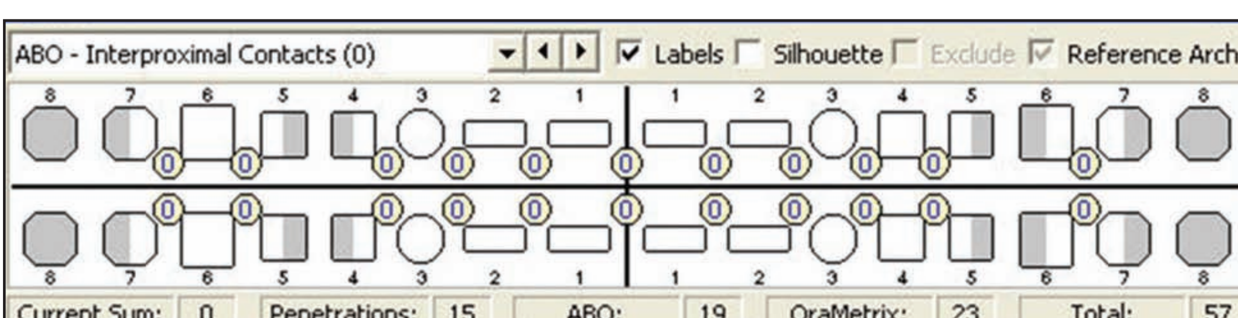


Fig. 9 Case 1. Computerized ABO-style score for quality check.

The system provides me with the unanticipated benefit of feedback. Everything is in the computer—the diagnostic models, the setup models, all the modifications I have made, the final models, and even computerized scores using ABO parameters for each model. With a few clicks of the mouse, I can see what worked well and what did not. I must say this is humbling, but it's made me a much better orthodontist. Following are a couple of treatment examples.

Case 1: Extraction

An 11½-year-old female with a mesocephalic facial pattern presented with a Class I occlusion, severe crowding, lateral crossbites, and impacted maxillary canines (Fig. 4, Table 1). This was a borderline case and could have been treated with or without extractions. The decision to extract was made because of the thin tissue over the mandibular central incisors and second molars, with the latter showing the potential to become impact-

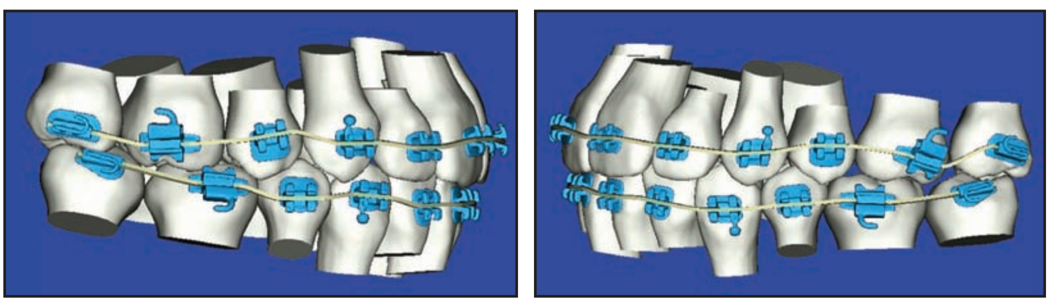


Fig. 10 Case 1. Initial archwires for perfected setup.

Order | Upper Wire | Lower Wire | Upper Disp. | Lower Disp.

	8|	7|	6|	5|	4|	3|	2|	1|	|1	|2	|3	|4	|5	|6	|7	|8
Insert wire beginning at tooth..		☐	☐		☐	☐	☐	☐	☐	☑	☐	☐		☐	☐	
Automatic Slot Filling / Lingual Torque		☐	☐		☐	☐	☐	☐	☐	☐	☐	☐		☐	☐	
Automatic Slot Filling / Facial Torque		☐	☐		☐	☐	☑	☑	☑	☑	☐	☐		☐	☐	
Buccal (+) Lingual (-) [mm]																
Occusal (+) Gingival (-) [mm]															0.5	
Torque Facial (+) Lingual (-) [deg]		-6					8	8	8	8						
Angulation Mesial (+) Distal (-) [deg]																
Rotation Mesial (+) Distal (-) [deg]																
A Limit Value [%]		100	100		100	100	100	100	100	100	100	100		100	100	

Order | Upper Wire | Lower Wire | Upper Disp. | Lower Disp.

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
Insert wire beginning at tooth..		☐	☐		☐	☐	☐	☐	☐	☑	☐	☐		☐	☐	
Automatic Slot Filling / Lingual Torque		☐	☐		☐	☐	☐	☐	☐	☐	☐	☐		☐	☐	
Automatic Slot Filling / Facial Torque		☐	☐		☐	☐	☐	☐	☐	☐	☐	☐		☐	☐	
Buccal (+) Lingual (-) [mm]																
Occusal (+) Gingival (-) [mm]															0.5	
Torque Facial (+) Lingual (-) [deg]															6	
Angulation Mesial (+) Distal (-) [deg]																
Rotation Mesial (+) Distal (-) [deg]																
B Limit Value [%]		100	100		100	100	100	100	100	100	100	100		100	100	

Fig. 11 Case 1. Wire modifications. A. Second maxillary archwire. B. Second mandibular archwire.

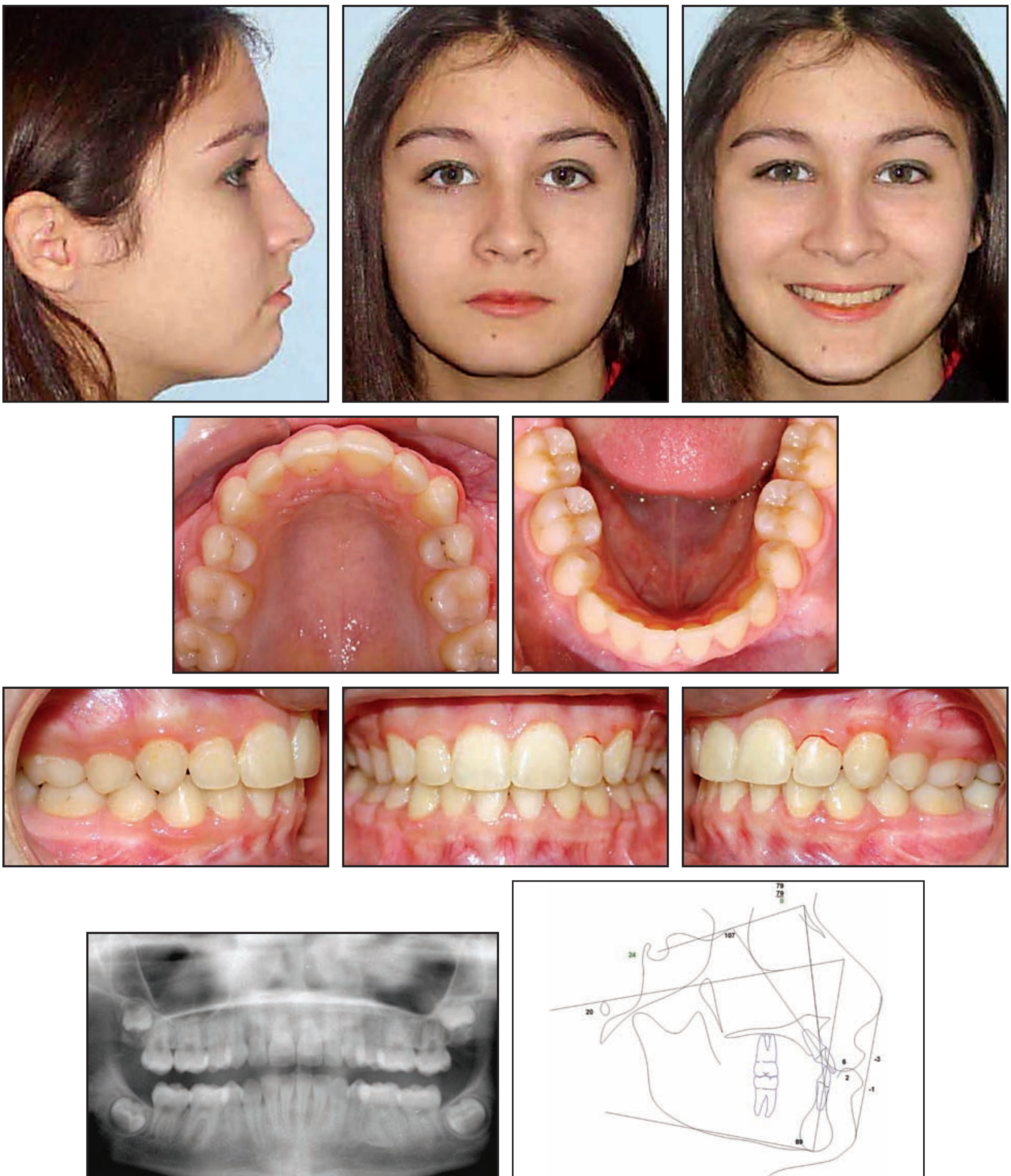


Fig. 12 Case 1. After 18 months of treatment with no wires bent by hand.

ed. The patient's records were scanned to create virtual diagnostic models (Fig. 5). The maxillary deciduous canines and maxillary and mandibular second premolars were then removed. Treatment was begun by placing .022" edgewise Orthos† brackets. Space closure was initiated using traditional edgewise closing mechanics with nickel titanium closing coils on .018" nickel titanium archwires.

Treatment progressed as planned. As the extraction spaces were closed, the maxillary canines and second molars erupted (Fig. 6). After 13 months, it was time to scan the teeth with brackets to create a therapeutic model. At this point, significant finishing work remained to be done (Fig. 7). Following my prescription, an OraMetrix laboratory technician produced an ideal setup, which I then checked and detailed (Fig. 8). The computerized score based on ABO parameters is an excellent tool for evaluating the therapeutic setup (Fig. 9). A robotically bent .019" × .025" copper nickel titanium archwire was placed along with Class II elastics about six weeks after the scanning (Fig. 10). The patient was seen again seven weeks later, and a modified archwire was ordered with 6° of lingual crown torque added to the maxillary right second molar and .5mm of extrusion added to the left second molar (Fig. 11A); 8° of lingual root torque had been previously added to the maxillary incisors. In addition, 6° of buccal crown torque and .5mm of extrusion were added to the mandibular left second molar (Fig. 11B).

Eighteen months after the patient began treatment, the appliances were removed and final records obtained (Fig. 12, Table 1). When the records were scanned into the SureSmile system for evaluation, the computerized ABO score was 28 (zero would be a perfect score; 30 is considered a passing mark). SureSmile significantly shortened the finishing phase of treatment, with no loss of quality, while increasing the predictability of treatment. Not a single wire was bent by hand in the treatment of this case.

†Trademark of Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867; www.ormco.com..

TABLE 2
CASE 2 CEPHALOMETRIC DATA

	Norm	Pre-treatment	Post-Treatment
SNA	82.0°	85.9°	86.0°
SNB	80.9°	81.8°	82.3°
SN	32.9°	23.6°	26.4°
FMA	23.9°	20.1°	21.4°
ANB	1.6°	4.1°	3.7°
U1-NA	4.3mm	8.2mm	3.9mm
U1-SN	102.8°	113.9°	108.6°
L1-NB	4.0mm	4.5mm	6.6mm
L1-MP	95.0°	91.3°	99.4°

Case 2: Nonextraction with 0° Brackets

A 41-year-old female with a dolichocephalic facial pattern presented with maxillary protrusion, an open bite, and mandibular crowding (Fig. 13, Table 2). Her main complaints were the diastema and protrusion. She had an end-on Class I occlusion and a 4.5mm overjet. Nonextraction treatment was pursued because of the relatively straight profile.

The patient's records were scanned into the SureSmile system to create diagnostic models, which showed a Class II tendency (Fig. 14). Treatment began with the placement of generic 0° .018" edgewise brackets and .014" nickel titanium archwires. To promote expansion, crimpable split-tube stops were placed mesial to the molars after the arches were fully engaged (Fig. 15).

Six weeks later, the teeth with brackets were scanned into the SureSmile system. As with Case 1, significant finishing work remained; the Class II malocclusion had actually increased (Fig. 16). Following my prescription, the OraMetrix laboratory did the initial setup, which I then detailed (Fig. 17). The computerized score using ABO parameters was 14 (Fig. 18). From this setup, the lab produced robotically bent .017" × .025" upper

(text continued on p. 174)

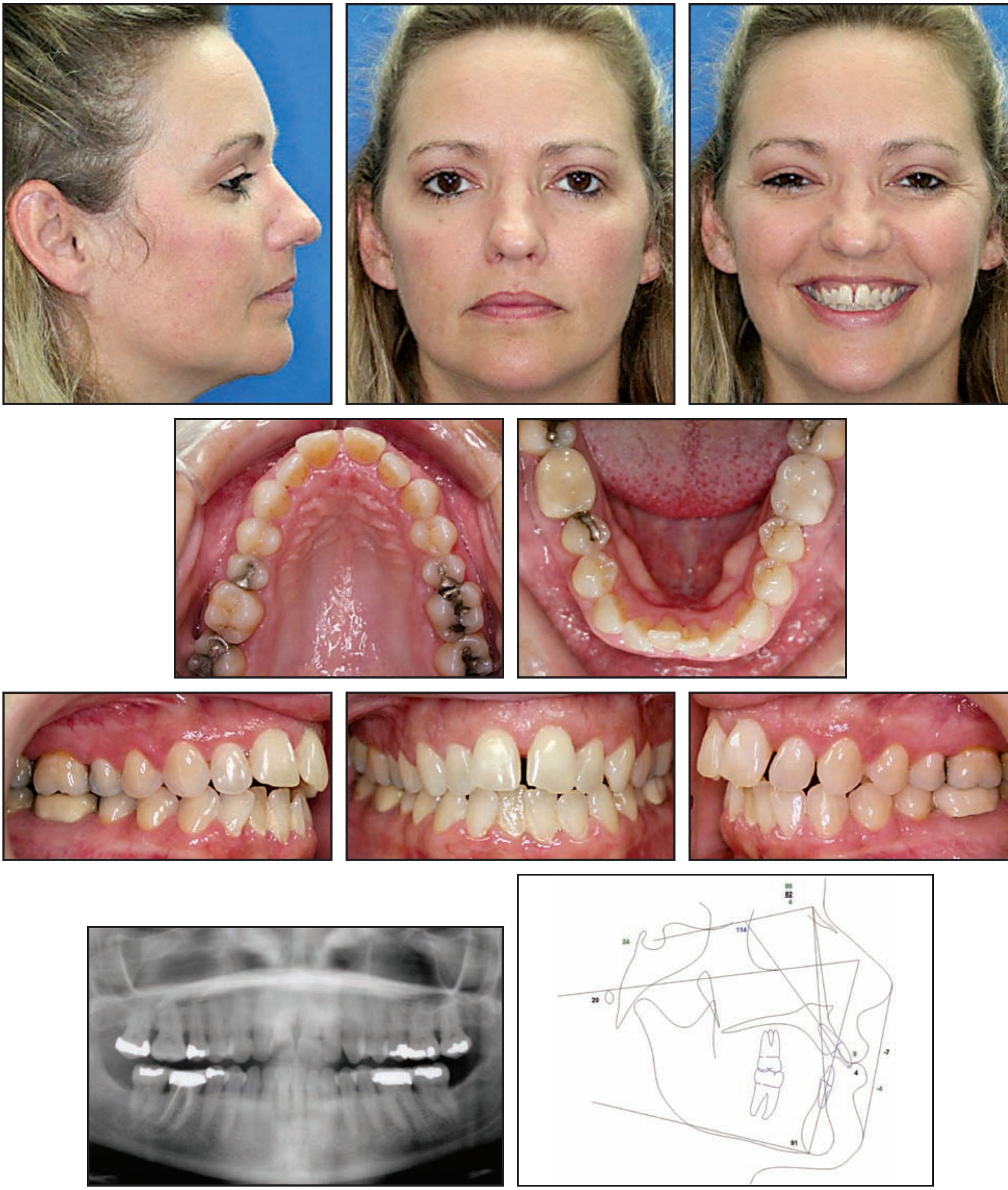


Fig. 13 Case 2. 41-year-old female patient with maxillary protrusion, open bite, and mandibular crowding.

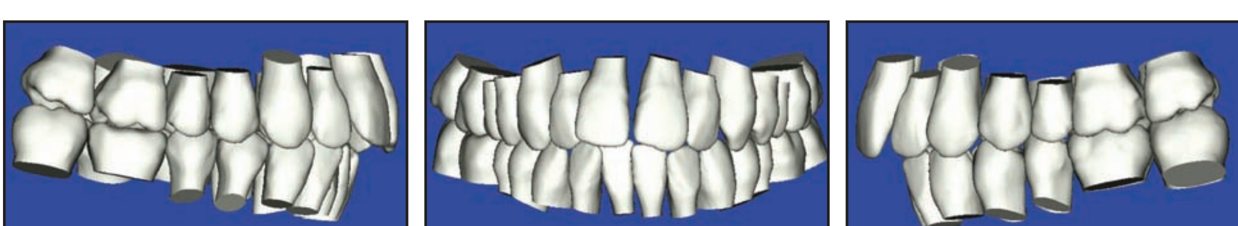


Fig. 14 Case 2. Pretreatment virtual diagnostic models.

Fig. 15 Case 2. Generic 0° brackets and .014" nickel titanium archwires, with crimpable split-tube stops at molars for expansion.

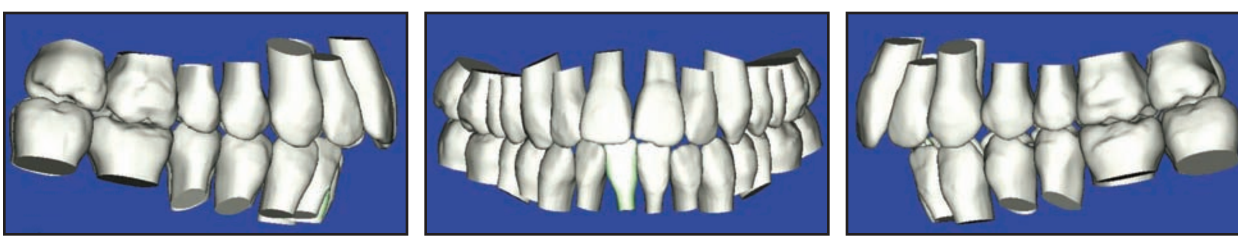


Fig. 16 Case 2. Therapeutic model for setup.

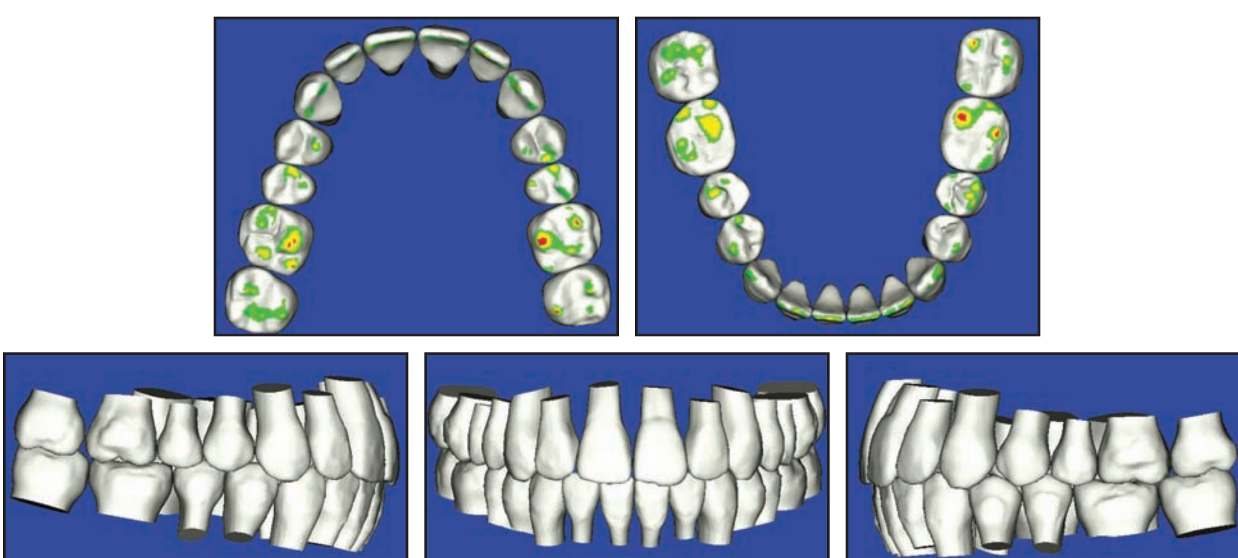


Fig. 17 Case 2. Virtual setup based on clinician's prescription and detailing.

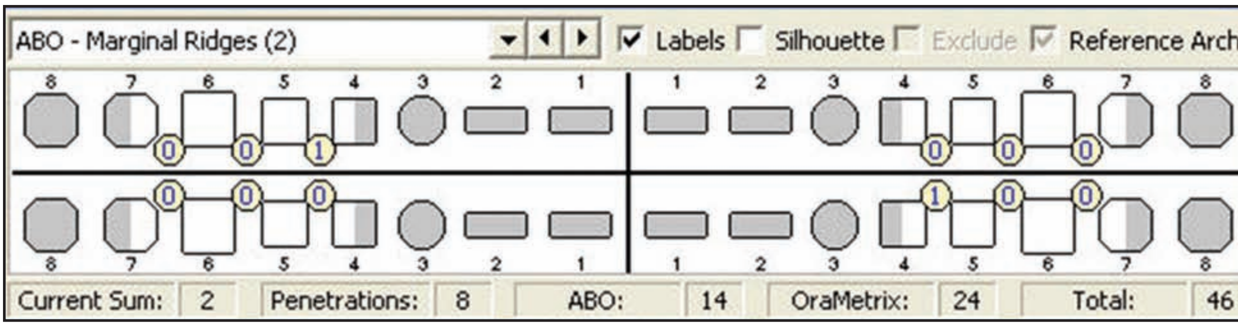


Fig. 18 Case 2. Computerized ABO-style score for quality check.

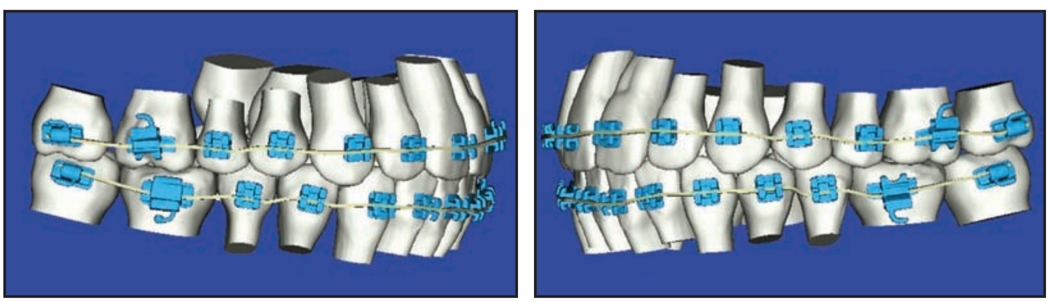


Fig. 19 Case 2. Initial archwires for perfected setup.

Order | Upper Wire | Lower Wire | Upper Disp. | Lower Disp.

A	8|	7|	6|	5|	4|	3|	2|	1|	|1	|2	|3	|4	|5	|6	|7	|8
Insert wire beginning at tooth..		☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	
Automatic Slot Filling / Lingual Torque		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Automatic Slot Filling / Facial Torque		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Buccal (+) Lingual (-) [mm]																
Occusal (+) Gingival (-) [mm]		-0.3								-0.4					-0.3	
Torque Facial (+) Lingual (-) [deg]		-11													-10	
Angulation Mesial (+) Distal (-) [deg]		-3	-3	-3	-3	-2					-2	-3	-3	-3	-3	
Rotation Mesial (+) Distal (-) [deg]																
Limit Value [%]		100	100	100	100	100	100	100	100	100	100	100	100	100	100	

Order | Upper Wire | Lower Wire | Upper Disp. | Lower Disp.

B	8|	7|	6|	5|	4|	3|	2|	1|	|1	|2	|3	|4	|5	|6	|7	|8
Insert wire beginning at tooth..		☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	
Automatic Slot Filling / Lingual Torque		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Automatic Slot Filling / Facial Torque		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Buccal (+) Lingual (-) [mm]																
Occusal (+) Gingival (-) [mm]					0.4	0.3					0.3	0.5				
Torque Facial (+) Lingual (-) [deg]							3	3	3	3	5					
Angulation Mesial (+) Distal (-) [deg]		3	3	3	3	2					2	3	3	3	3	
Rotation Mesial (+) Distal (-) [deg]																
Limit Value [%]		100	100	100	100	100	100	100	100	100	100	100	100	100	100	

Fig. 20 Case 2. Wire modifications. A. Second maxillary archwire. B. Second mandibular archwire.

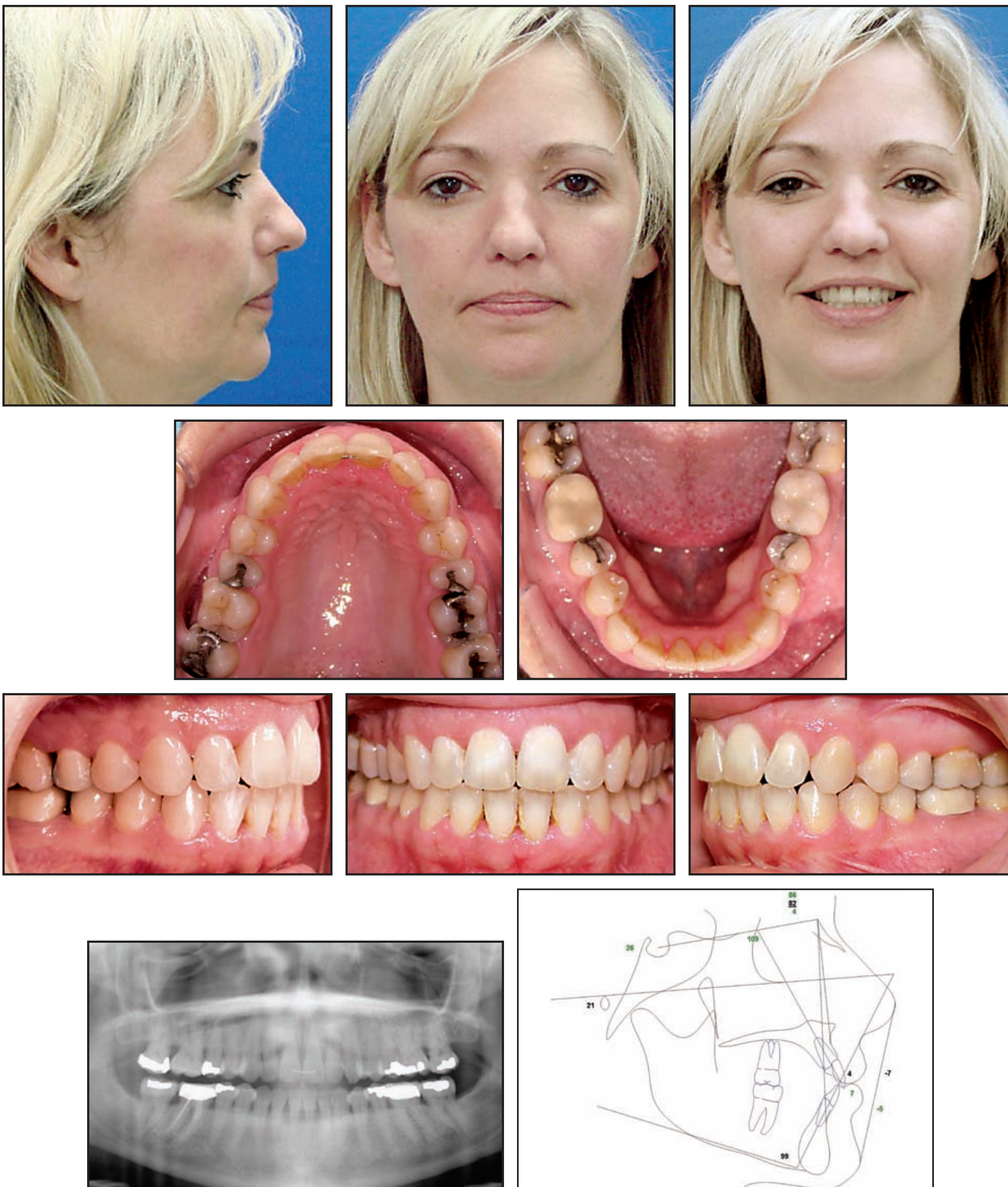


Fig. 21 Case 2. After eight months of treatment using generic 0° brackets, with no wires bent by hand.

and .016" × .022" lower copper nickel titanium archwires with increased curves of Spee to help prevent the bite from opening up, keeping the upper second molars slightly out of occlusion (Fig. 19). Six weeks after the intraoral scan, the wires were placed along with Class II triangular elastics. Eight weeks later, modified .017" × .025" copper nickel titanium archwires were ordered with increased forward angulation of the lower buccal segments and increased distal angulation of the upper buccal segments. Lingual root torque was added to the lower anterior teeth, and a few vertical adjustments were made on selected teeth (Fig. 20). These wires were placed two weeks later, and the triangular Class II elastics were continued.

Eight months after the initial bonding and eight weeks after the final wires were placed, the patient was debonded (Fig. 21, Table 2). Final records were obtained and scanned into the SureSmile system. The computerized score for this patient was 32. Again, not a single wire was bent by hand to treat this patient.

Discussion

SureSmile has worked out extremely well for my practice. It has added about 7% to our expenses, but we have experienced practice growth even in this difficult market. Initially, I offered it as an option to patients at an additional charge. After working with SureSmile for about a year and seeing the results, I decided I did not want to treat patients any other way, so I increased our fees to cover the additional expense. For the past three years, we have treated all fully bonded cases with SureSmile. Our patients and referring dentists are extremely happy with the results, and the word has spread. In my opinion, the combination of rapid treatment and high quality that we can not only see, but document, has been the key to this positive response. My decision to implement SureSmile has definitely paid off.

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MANAGEMENT & MARKETING

(Editor's Note: This quarterly JCO column is compiled by Contributing Editor Robert Haeger. Every three months, Dr. Haeger presents a successful approach or strategy for a particular aspect of practice management. Your suggestions for future topics or authors are welcome.)

Have you ever wondered what happens in the exam room after you leave a prospective new patient with your treatment coordinator? How well does your TC understand the needs of the patient and communicate the benefits of your office? How does your TC or other factors influence the patient's decision on whether to start treatment? How does one dentist referral pattern compare to another?

Although you could monitor and evaluate your TC's behavior with a hidden camera, people tend to put forth greater effort when they know they're under observation. I have gained much more insight by addressing these questions through monthly reporting. My office now monitors the performance of my TCs for all types of patients (child, adult, Phase I, full treatment, surgical, etc.), along with the return on investment for our marketing dollars and the specific vocabulary used by top referring dentists. All this information helps us target the need for our staff continuing education.

Probably the most crucial part of a detailed analysis is tracking the changes for all these parameters over time, by month, quarter, and year. This allows us to be proactive and take the business of orthodontics forward under challenging economic conditions. Ideally, such reports should be included in practice-management software, which would allow cross-comparisons among different offices.

ROBERT S. HAEGER, DDS, MS

Increasing New Patient Starts by Analyzing Referral Sources and Treatment Coordinators

A prospective patient's initial examination may be the most important visit in the entire orthodontic treatment process. The patient's perception of the practice, which starts to form with the referral and the initial telephone call, is largely shaped by his or her experience at this first appointment. It is essential to understand the dynamics involved in attracting new patients to the practice and convincing them that it's the best place for them to receive care. To this end, I have designed a system for my practice to record, monitor, and analyze the success of our marketing campaigns, referrals, and treatment coordinator (TC) activities in terms of converting initial examinations to patient starts. These data are continually updated, allowing me to easily detect changes and trends over time.

Analysis of initial examination appointments

Dr. Haeger

Dr. Haeger is a Contributing Editor of the *Journal of Clinical Orthodontics*, a board member of the Schulman Study Group, and in the private practice of orthodontics at 24909 104th Ave., S.E., Suite 203, Kent, WA 98030; e-mail: drhaeger@mybraces.net.

Referral of new patients to our office is the greatest compliment we can receive. Please take a moment to let us know how you heard about our office. Please check all sources that apply and circle the main reason you selected our office.

Patient: ____________________________________

____ Dentist	____ Internet
____ Family member/sibling	____ Insurance company
____ Friends/coworkers	____ Phone book
____ One of Dr. Haeger's employees	____ Church
____ Sports teams/sponsorship	____ Advertisement

____ Other (please state:) ____

Please list all of your friends who referred you here so that we can thank them properly.

Fig. 1 New patient referral information form.

should focus on the following factors:

- How effective is the TC in persuading patients to begin orthodontic treatment in my practice?
- What are the sources of new patients, and what percentage of patients from each source decide to start treatment?
- What are the patterns of referrals from dentists? Are dentists convincing patients that they need care, and if not, can I help them improve their communication skills?
- How well do we understand the complexities of adult, surgical, and multidisciplinary patients and their decisions about seeking care?

This article demonstrates how the data I have collected can be organized into tables and interpreted to develop concrete strategies for attracting and retaining new patients.

Procedure

To allow maximum versatility in data analysis, the following information is recorded using Microsoft Excel* at the initial examination:

- Dentist
- Patient name
- Age at initial examination
- Examination date/month/quarter
- TC
- Child (up to age 18) or adult
- Proposed treatment:
  - Limited
  - Phase I
  - Full
  - Invisalign**
  - Surgical
  - Multidisciplinary
  - Transfer
  - Nothing for now
- Status upon leaving the office:
  - Start today
  - Start shortly after the examination
  - Memo (treatment needed but decision pending)
  - Observation/recall (not ready to start yet)
  - Treatment declined
  - No treatment needed
- How the patient heard about the office, and the primary reason for the visit (Figure 1 shows the form I give the new patient or responsible party at the initial appointment to collect referral information)

Practices with multiple offices, orthodontists, or associates might need to collect several sets of data.

*Microsoft Corp., Redmond, WA; www.microsoft.com. We are in the process of incorporating these charts into the Oasys practice-management system (Oasys Practice, 370 Winkler Drive, Suite A, Alpharetta, GA 30004; www.oasys-practice.com), which will make the data less time-consuming to enter and easier to format.

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TABLE 1
OVERALL SIX-MONTH RESULTS OF INITIAL EXAMINATION APPOINTMENTS

Month	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Jan	12	1	3	17	15	0	48
	25.0%	2.1%	6.3%	35.4%	31.3%	0.0%	100.0%
Feb	5	3	0	4	1	0	13
	38.5%	23.1%	0.0%	30.8%	7.7%	0.0%	100.0%
Mar	24	4	8	24	13	1	74
	32.4%	5.4%	10.8%	32.4%	17.6%	1.4%	100.0%
April	17	1	6	17	4	0	45
	37.8%	2.2%	13.3%	37.8%	8.9%	0.0%	100.0%
May	18	1	16	13	2	0	50
	36.0%	2.0%	32.0%	26.0%	4.0%	0.0%	100.0%
Jun	18	0	11	5	2	2	38
	47.4%	0.0%	28.9%	13.2%	5.3%	5.3%	100.0%
Total	94	10	44	80	37	3	268
	35.1%	3.7%	16.4%	29.9%	13.8%	1.1%	100.0%

TABLE 2
SIX-MONTH RESULTS FOR ONE TREATMENT COORDINATOR (TC A)

Month	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Jan	8	1	3	11	7	0	30
	26.7%	3.3%	10.0%	36.7%	23.3%	0.0%	100.0%
Feb	4	3	0	2	0	0	9
	44.4%	33.3%	0.0%	22.2%	0.0%	0.0%	100.0%
Mar	15	2	7	12	3	1	40
	37.5%	5.0%	17.5%	30.0%	7.5%	2.5%	100.0%
April	12	1	6	8	1	0	28
	42.9%	3.6%	21.4%	28.6%	3.6%	0.0%	100.0%
May	9	1	13	8	1	0	32
	28.1%	3.1%	40.6%	25.0%	3.1%	0.0%	100.0%
Jun	10	0	7	4	2	2	25
	40.0%	0.0%	28.0%	16.0%	8.0%	8.0%	100.0%
Total	58	8	36	45	14	3	164
	35.4%	4.9%	22.0%	27.4%	8.5%	1.8%	100.0%

Data Tabulation and Analysis

Table 1 provides a good overview of the results of initial examination appointments. Combining the data in the “Start Today” and “Start Later” columns yields the total percentage of patients who committed to treatment, which is one of the most important pieces of data collected. Although this general information is valuable for monitoring the overall health of a practice, we need to examine the data in more detail to understand how office policies or the communication styles of particular TCs affect the results of initial appointments.

Table 2 goes one step further by examining the results of the initial appointments of a particular TC (let’s call her TC A). In January, 30.0% of A’s patients started treatment, while 36.7% were

TABLE 3
QUARTERLY SUMMARY OF RESULTS FOR ONE TREATMENT COORDINATOR (TC A)

Quarter	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
1	27	6	8	25	10	1	77
	35.1%	7.8%	10.4%	32.5%	13.0%	1.3%	100.0%
2	31	2	28	20	4	2	87
	35.6%	2.3%	32.2%	23.0%	4.6%	2.3%	100.0%
Total	58	8	36	45	14	3	164
	35.4%	4.9%	22.0%	27.4%	8.5%	1.8%	100.0%

TABLE 4
ONE-MONTH RESULTS BY PATIENT TYPE
FOR THREE DIFFERENT TREATMENT COORDINATORS

	TC	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Child	A	6	0	2	11	2	0	21
		28.6%	0.0%	9.5%	52.4%	9.5%	0.0%	100.0%
	B	1	0	0	2	1	0	4
		25.0%	0.0%	0.0%	50.0%	25.0%	0.0%	100.0%
	C	2	0	0	4	2	0	8
		25.0%	0.0%	0.0%	50.0%	25.0%	0.0%	100.0%
Child Total		9	0	2	17	5	0	33
		27.3%	0.0%	6.1%	51.5%	15.2%	0.0%	100.0%
Adult	A	2	1	1	0	5	0	9
		22.2%	11.1%	11.1%	0.0%	55.6%	0.0%	100.0%
	B	1	0	0	0	3	0	4
		25.0%	0.0%	0.0%	0.0%	75.0%	0.0%	100.0%
	C	0	0	0	0	2	0	2
		0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Adult Total		3	1	1	0	10	0	15
		20.0%	6.7%	6.7%	0.0%	66.7%	0.0%	100.0%
Overall Total		12	1	3	17	15	0	48
		25.0%	2.1%	6.3%	35.4%	31.3%	0.0%	100.0%

not ready to start ("Observation" column). In February, 77.7% of A's patients started care. Table 3 shows a quarterly summary of A's patient statistics. All this information can offer some insight into the communication skills of each TC in the office, and is also valuable in setting goals and determining bonuses.

The true power of collecting and analyzing data becomes evident when we examine the results of particular TCs for specific categories of patients. Patients can be grouped by age or by the type of treatment recommended. Table 4 divides each TC's patients into children and adults, allowing us to track their success with these two very different groups. Although this table includes data for only one month, quarterly and annual tracking can also be performed. Such information can help identify strategies for communicating with specific types of patients that can be discussed in staff meetings and used to develop continuing-education classes.

TABLE 5
ONE-MONTH RESULTS FOR PATIENTS NEEDING FULL TREATMENT

	TC	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Child	A	5	0	2	0	5	0	12
		41.7%	0.0%	16.7%	0.0%	41.7%	0.0%	100.0%
	B	14	0	2	0	2	0	18
		77.8%	0.0%	11.1%	0.0%	11.1%	0.0%	100.0%
	C	33	2	16	0	6	0	57
		57.9%	3.5%	28.1%	0.0%	10.5%	0.0%	100.0%
Child Total		52	2	20	0	13	0	87
		59.8%	2.3%	23.0%	0.0%	14.9%	0.0%	100.0%
Adult	A	4	1	2	0	4	0	11
		36.4%	9.1%	18.2%	0.0%	36.4%	0.0%	100.0%
	B	7	1	1	0	6	0	15
		46.7%	6.7%	6.7%	0.0%	40.0%	0.0%	100.0%
	C	18	2	14	0	6	1	41
		43.9%	4.9%	34.2%	0.0%	14.6%	2.4%	100.0%
Adult Total		29	4	17	0	16	1	67
		43.3%	6.0%	25.4%	0.0%	23.9%	1.5%	100.0%

The traditional conversion rate (starts/exams) assumes that patients under observation will eventually start treatment, but this assumption may or may not be correct. Evaluating only the data for patients needing full treatment provides a better indication of our communication skills at the initial appointment. Table 5 shows the results for each TC, again grouped by patient age. This information is also compiled for surgical, multidisciplinary, Phase I, and Invisalign patients.

Tables 6 through 9 break down referral sources to show the impact of marketing programs or referrals by particular dentists on patient statistics. Table 6 covers the various means by which patients learn about our office. For example, 91% of all new adult patients are referred by their dentists or family members. New child patients are three times as likely as adults to learn about the practice from friends. We use this information to help determine how to spend our marketing dollars; a practice with multiple marketing campaigns could evaluate which ones are most successful for each patient age group.

By combining information on referrals with data on the percentages of patients who start or decline treatment, we can identify the most fruitful referral sources. Table 7 shows that 28.4% of child referrals from dentists start treatment, compared to 42.4% of those referred by family members who have been treated in my practice. Eleven

TABLE 6
SOURCES OF NEW PATIENTS (JANUARY-JUNE)

	Child	Adult	Total
Dentist	109	64	173
	60.9%	71.9%	64.6%
Family	33	17	50
	18.4%	19.1%	18.7%
Friends	30	5	35
	16.8%	5.6%	13.1%
Employee	1	0	1
	0.6%	0.0%	0.4%
Internet	3	1	4
	1.7%	1.1%	1.5%
Insurance	2	1	3
	1.1%	1.1%	1.1%
Yellow Pages	1	1	2
	0.6%	1.1%	0.8%
Total	179	89	268
	100.0%	100.0%	100.0%

TABLE 7
RESULTS FOR PATIENTS REFERRED BY DENTISTS VS. FAMILY MEMBERS (JANUARY-JUNE)

	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Dentist							
Child	30	1	16	50	12	0	109
	27.5%	0.9%	14.7%	45.9%	11.0%	0.0%	100.0%
Adult	26	3	17	0	15	3	64
	40.6%	4.7%	26.6%	0.0%	23.4%	4.7%	100.0%
Total	56	4	33	50	27	3	173
	32.4%	2.3%	19.1%	28.9%	15.6%	1.7%	100.0%
Family Member							
Child	13	1	5	12	2	0	33
	39.4%	3.0%	15.2%	36.4%	6.1%	0.0%	100.0%
Adult	8	1	3	1	4	0	17
	47.1%	5.9%	17.7%	5.9%	23.5%	0.0%	100.0%
Total	21	2	8	13	6	0	50
	42.0%	4.0%	16.0%	26.0%	12.0%	0.0%	100.0%

TABLE 8
RESULTS FOR PATIENTS REFERRED BY PARTICULAR DENTISTS (JANUARY-JUNE)

	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Dentist A							
Child	0	0	0	6	2	0	8
	0.0%	0.0%	0.0%	75.0%	25.0%	0.0%	100.0%
Adult	0	0	1	0	1	0	2
	0.0%	0.0%	50.0%	0.0%	50.0%	0.0%	100.0%
Total	0	0	1	6	3	0	10
	0.0%	0.0%	10.0%	60.0%	30.0%	0.0%	100.0
Dentist B							
Child	2	1	0	3	1	0	7
	28.6%	14.3%	0.0%	42.9%	14.3%	0.0%	100.0%
Adult	2	0	1	0	1	0	4
	50.0%	0.0%	25.0%	0.0%	25.0%	0.0%	100.0%
Total	4	1	1	3	2	0	11
	36.4%	9.1%	9.1%	27.3%	18.2%	0.0%	100.0%

TABLE 9
RESULTS FOR PARTICULAR REFERRING DENTISTS BY TREATMENT TYPE (JANUARY-JUNE)

	Start Today	Start Later	Memo	Observation	Decline	Not Needed	Total
Dentist A							
Full	3	0	1	0	2	0	6
	50.0%	0.0%	16.7%	0.0%	33.3%	0.0%	100.0%
Limited	1	1	0	0	0	0	2
	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Nothing now	0	0	0	3	0	0	3
	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
Total	4	1	1	3	2	0	11
	36.4%	9.1%	9.1%	27.3%	18.2%	0.0%	100.0%
Dentist B							
Full	3	0	1	0	0	0	4
	75.0%	0.0%	25.0%	0.0%	0.0%	0.0%	100.0%
Limited	0	0	1	0	0	0	1
	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
Phase I	1	0	0	0	0	0	1
	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Invisalign	0	0	1	0	0	0	1
	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
Surgical	0	1	0	0	1	0	2
	0.0%	50.0%	0.0%	0.0%	50.0%	0.0%	100.0%
Multidisciplinary	1	0	0	0	0	0	1
	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Nothing now	0	0	0	2	0	1	3
	0.0%	0.0%	0.0%	66.7%	0.0%	33.3%	100.0%
Total	5	1	3	2	1	1	13
	38.5%	7.7%	23.1%	15.4%	7.7%	7.7%	100.0%

percent of the children referred by their dentists decline treatment, compared to only 6% of the siblings.

Proper data collection also allows for analysis of specific dentists and their referral patterns, as shown in Table 8. Such information can lay the groundwork for fruitful discussions with these dentists over lunch or at conferences. For example, why does one dentist have a much higher start rate for adults than for children? What is that dentist saying to his adult patients that makes so many of them start orthodontic treatment? The table shows that none of Dentist A's patients have committed to starting treatment, although 75% of them are under observation. A discussion with Dentist A would focus on when he is referring patients and what criteria my office uses to assess the need for Phase I treatment.

Table 9 breaks up each dentist's referrals by the type of orthodontic treatment recommended. The orthodontist can use this information to analyze his or her own success in communicating with specific types of patients, as well as to track the referral patterns of each dentist.

Discussion

Analyzing start rates for new patients points us toward several strategies for improving our practices and patient care. The obvious starting point is to evaluate the effectiveness of TCs in communicating with prospective patients about the benefits of orthodontic treatment and why they should choose our practice. Historical data can help us establish reasonable goals for each type of patient and guide us in training new TCs. Our data-collection process allows us to determine which TCs are generating more starts for children, adult, Phase I, Invisalign, surgical, multidisciplinary, and transfer patients. This gives us a clear picture of the strengths and weaknesses of each TC and helps us identify TCs who are particularly successful with certain types of patients. Those individuals can then share their techniques with the entire staff, while TCs who are struggling can be targeted for additional training.

Our second major area of study is referral sources. By recording the primary source of each referral, we can track the revenue generated by specific marketing strategies and better direct future expenditures. The most meaningful information for our office pertains to referring dentists. Careful analysis has resulted in several strategies:

• A particular dental office had extremely high conversion rates for adult, surgical, and multidisciplinary patients. I met with the dentist to find out the specific language he and his colleague used when making these referrals. Now, when I meet with other dentists, I convey this same wording to them.

• Certain dental offices refer patients who invariably end up under observation. When I meet with these dentists, I describe my approach to Phase I treatment and how our pretreatment recall system works. We also try to schedule shorter exam appointments for patients from these offices.

• By monitoring referral data over time, we quickly notice any changes in referral patterns and conversion rates of particular dental offices. This allows us to investigate the reasons for these changes and take any action needed.

• One office hired a new associate whose referrals seldom started treatment. We invited this dentist to sit in on an initial examination and discussed successful referral techniques. These efforts have brought the associate's conversion rate up to a normal level.

The same kind of analysis can be used for multiple practice locations, associate orthodontists, or recall patient visits.

Keeping our practices successful in this challenging economic climate will require increasingly strategic business techniques. The best way to understand your practice is to record concrete data, monitor it over time, and analyze the information regularly. The result will be the best possible use of your marketing funds. Proactive offices that employ procedures such as those described here will have the best chance of weathering the economic downturn. ❑

Boston: Hub of Culture and History

DAVID S. VOGELS III

Boston beckons the AAO for an early-spring annual meeting, May 1-5. The city's most common nicknames—the Hub, the Athens of America, the Cradle of Liberty—reflect its status as both a crossroads of world culture and a seat of the nation's history. Whether you're seeking the latest hot trends or the ashes of the American Revolution, Boston has much to offer.

In our annual convention preview, JCO highlights the things to do and places to see.

Climate and Transportation

Early May in Boston can be cool and foggy, with average highs in the low 60s and lows in the upper 40s. Plan for unsettled weather, but hope for a few of those gloriously warm New England spring days with all the flowers in bloom.

Logan International Airport is not one of the easiest facilities to navigate. Each of the four terminals has its own ground transportation outside the baggage claim area; look for the signs for taxis (about $35 to Hynes Convention Center) or shared vans ($14 one way).

Once you're in town, the Massachusetts Bay Transit Authority's subway system (the famous "T", some of which is above ground) is an easy way to get around. The convention center is on the Green Line. One-way fares to anywhere in the city are $1.70 if you buy a CharlieCard in advance (www.mbta.com), $2 if you pay as you go.

Attractions

To get an overview of the city, take one of the sightseeing or historical **Boston Harbor Cruises,** or book one of the ubiquitous **Boston Duck Tours,** which use World War II amphibious vehicles to tour Boston neighborhoods and then cruise down the Charles River.

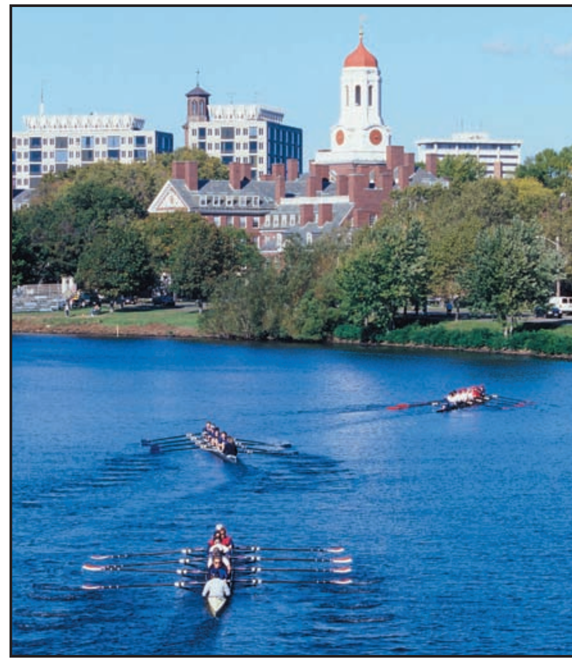
There are two economical ways to visit the major historic and cultural sites. The Go Boston Card (www.gobostoncard.com) provides general admission to dozens of attractions in the city and throughout New England, including virtually all of those listed below, with one-, three-, five-, and seven-day options.

CityPass offers about a 50% savings on admission to six top locations, including one of the world's great art institutions, the **Museum of Fine Arts** (presenting special exhibits on Japanese and decorative arts during the AAO meeting). Another highlight is the splendid **New England Aquarium** (offering a family field trip called "Tidepool Trek" on May 2 and a class on pond and river animals on May 5). The **Museum of Science** is running an IMAX film called "The Greatest Places" and an exhibit on women in science. The **John F. Kennedy Presidential Library and Museum** focuses on presidential memorabilia and archives. The **Harvard Museum of Natural History,** across the Charles River in Cambridge, is also included in the CityPass; its adjacent **Peabody Museum of Archaeology and Ethnology** has exhibits on "Lakota Images of the Contested West" and "The

Boldface names in this article are listed in the Directory on pp. 190-192 with their telephone numbers and street addresses.
For website links, click on the boldfaced or underlined name within the text.

Continuous red line represents the Freedom Trail. (Map courtesy of the U.S. National Park Service.)

The Giant Ocean Tank, a four-story coral reef exhibit, impresses visitors at the New England Aquarium. (Photo courtesy of New England Aquarium.)



Crew boats on the Charles River, with Harvard University in the background. (Photo courtesy of Greater Boston CVB.)

Archaeology and History of the Indian College and Student Life at Colonial Harvard". Finally, the pass provides admission to the **Skywalk Observatory** atop the Prudential Center, along with an audio tour.

The **Isabella Stewart Gardner Museum** houses a gem of a collection assembled by a wealthy Boston couple around the turn of the last century; during the AAO convention, it will feature an exhibit called "Journeys East: Isabella Stewart Gardner and Asia". Other specialized museums include the **Boston Children's Museum,** the **Institute of Contemporary Art,** the **National Center of Afro-American Artists** (with a show on "A Nubian King's Burial Chamber") and the **Society of Arts and Crafts** (presenting "American Enamels").

Just across the Charles River, in the Charlestown neighborhood, attractions include the **U.S.S. Constitution** ("Old Ironsides") and Museum, and the **Bunker Hill Monument** (no elevator!). In Cambridge, the distinguished Fogg and Busch-Reisinger museums at Harvard are closed for renovation, but the **Arthur M. Sackler Museum** is presenting highlights from all three collections. The **MIT Museum** is focusing on contemporary sculptor Arthur Ganson; its **Hart Nautical Gallery** is a tour de force of underwater engineering. MIT is also sponsoring the Cambridge Science Festival at various locations through May 3.

Farther afield, top attractions include the **Adams National Historic Park** (homes of John and John Quincy Adams) in Quincy, the **Hull Lifesaving Museum** at Point Allerton, **Plimoth Plantation** (a replica of Wampanoag and colonial settlements from the 1600s) in Plymouth, and the **Rose Art Museum** (featuring a Hans Hofmann painting exhibit) at Brandeis University in Waltham.

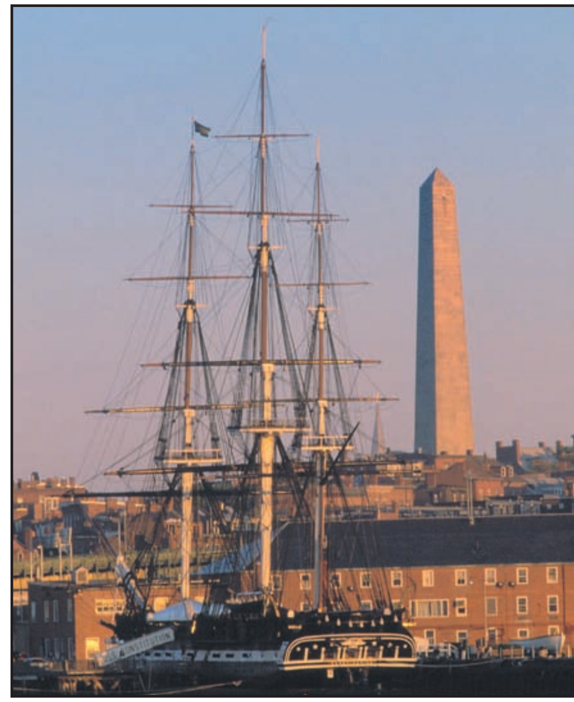
The best way to see historic Boston is to walk the 2½-mile Freedom Trail, marked off by red bricks in the pavement. Don't miss **Faneuil Hall,** the market built in 1742, now filled with charming shops; **Paul Revere House;** and the **Old North Church,** where Revere flashed his legendary warning of the British advance. In fact, the city is full of stunning church buildings, including the **First Church of Christ, Scientist** (the "Mother Church") and **Trinity Church** in Copley Square.

Performing Arts

Boston has perhaps the longest tradition of musical excellence in the United States. The **Boston Symphony Orchestra,** conducted by Colin Davis, presents a program featuring the stunning *Te Deum* by Hector Berlioz on April 29-30 and May 1-2 in Symphony Hall. A talented early-music group, Boston Baroque, will perform "Mozart and the Haydns" (Franz Joseph and Michael) on May 1-2 in **Jordan Hall** at the New England Conservatory of Music. Also in Jordan Hall, America's leading soprano, Dawn Upshaw, will be in recital on May 3. The Moët Trio performs chamber music by Ludwig van Beethoven, Joan Tower, and Maurice Ravel on May 3 in the Gardner Museum. An intriguing world-music program, Shelley Neill's "Irish Eyes Gypsy Soul", is on tap on May 1 at the **Cambridge Multicultural Arts Center.**

Opera Boston presents Bedrich Smetana's *The Bartered Bride* on May 1, 3, and 5 in the Cutler Majestic Theatre. The **Boston Lyric Opera** has W.A. Mozart's *Don Giovanni* running through May 5 at the Shubert Theatre. For dance buffs, the **Boston Ballet** is presenting Peter Ilyich Tchaikovsky's *The Sleeping Beauty* through May 3 at the Citi Performing Arts Center, and Alvin Ailey's American Dance Theater 50th Anniversary Celebration runs April 28-May 3 at the **Boston Opera House**.

The Opera House is also presenting a touring production of the Tony-award-winning Broadway musical, *Spring Awakening,* April 28-May 24. The **Boston University College of Fine Arts** offers two dramatic plays, *I Am My Own Wife* (through May 10, at BU's TheatreLab) and *Trumpery: The Darwin Project* (through May 3, on the BU Theatre Mainstage). The "longest-running play in the history of the American theater", *Shear Madness,* is still bringing laughs at the **Charles Playhouse,** which is also presenting the ever-popular Blue Man Group. If you prefer improvisational comedy, try **ImprovBoston** or the **Improv Asylum.**



The U.S.S. Constitution, "Old Ironsides", is moored in the Charlestown Navy Yard. (Photo courtesy of Greater Boston CVB.)

Restaurants and Nightlife

Restaurant recommendations are provided by our sister publication, *Sommelier Journal* (www.sommelierjournal.com). For fine dining, our top choices are **L'Espalier,** newly settled in the swanky Back Bay Mandarin Oriental; the highly regarded **No. 9 Park,** across the street from the state capitol; the wine-friendly **Meritage,** in the Boston Harbor Hotel; the innovative **Clio** and its sushi bar, **Uni,** in the Eliot Hotel; the hip **Troquet,** overlooking Boston Common; the elegant **Radius,** in the Financial District; and the classy **Aujourd'hui,** in the Four Seasons Hotel.

For more bistro-like fare, try the influential and unsurpassed **Hamersley's Bistro** or the more refined **Mistral,** both on the South End. If you're craving a New England lobster dinner, go to the venerable **Locke-Ober** or one of the many **Legal**

Fenway Park, home to the Boston Red Sox since 1912. (Photo courtesy of Greater Boston CVB.)

Sea Foods locations. And to satisfy a sweet tooth, don't miss the Chocolate Bar at **Café Fleuri** in the Langham Hotel.

The bar scene is led by the infamous **Cheers** on Beacon Hill; nowadays, it's more of a tourist attraction, with a duplicate location in the Faneuil Hall Marketplace. For live music, go to **T.T. The Bear's Place** (punk rock and new wave) or **Ryles Jazz Club** in Cambridge, **Scullers Jazz Club** at the Doubletree Guest Suites, the **Top of the Hub** at the Prudential Center (jazz), or **Wally's Café** (jazz) on the South End.

Sports and Recreation

The **Boston Red Sox** are on the road during the convention, but will be home at Fenway Park for games against Cleveland, May 6-7, and Tampa Bay, May 8-10. The **Volvo Ocean Race,** one of the world's premier yachting events, visits Boston's Fan Pier from April 25 through May 16. Walkers can exercise for charity in the May 3 **Project Bread Walk for Hunger,** a 20-mile trek through Boston, Brookline, Newton, and Cambridge.

Weather permitting, the Boston area has some classic golf layouts worth exploring. Outstanding public tracks include the **Braintree Municipal Golf Course, Brookmeadow Country Club** in Canton, **George Wright Golf Course** in Hyde Park, **Newton Commonwealth Golf Course, Pinehills Golf Club** in Plymouth, **Shaker Hills Golf Course** in Harvard, and **William J. Devine Franklin Park Golf Course** near downtown Boston.

Shops, galleries, and restaurants line Newbury Street in the Back Bay. (Photo courtesy of Greater Boston CVB.)

Shopping

Premier shopping malls include **Copley Place** in the Back Bay, **Downtown Crossing,** and **The Shops at Prudential Center.** Book lovers will appreciate the historic **Brattle Book Shop** downtown and the **Harvard Book Store** in Cambridge.

The Back Bay's Newbury Street is the place to stroll for boutiques and galleries, including **Alpha Gallery** (contemporary), **Gallery NAGA** (contemporary), **Robert Klein Gallery** (photography), **Lanoue Fine Art, L'Attitude** (glass and other media), **Mercury Gallery** (fine art), **Pucker Gallery** (eclectic contemporary), and **Martha Richardson Fine Art.** Other artistic neighborhoods are Beacon Hill, featuring **Judith Dowling Asian Art** and **Gurari Collections** (antiquarian and contemporary), and the South End, with **Berenberg Gallery** (contemporary folk art), **Boston Sculptors Gallery, Hamill Gallery of Tribal Art** (African), and **Vessels Gallery** (pottery). The **Keiko Gallery** near Boston Common features contemporary Japanese arts and crafts.

DIRECTORY

Attractions

Attractions	Address*	Phone**
Adams National Historic Park	135 Adams St., Quincy	(617) 770-1175
Arthur M. Sackler Museum	485 Broadway, Cambridge	(617) 495-9400
Boston Children's Museum	300 Congress St.	(617) 426-6500
Boston Duck Tours	3 Copley Place	(617) 267-DUCK
Boston Harbor Cruises	One Long Whart	(617) 227-4321
Bunker Hill Monument	Monument Square, Charlestown	(617) 242-5641
Faneuil Hall	4 South Market Building	(617) 523-1300
First Church of Christ, Scientist	175 Huntington Ave.	(617) 450-2000
Hart Nautical Gallery	55 Massachusetts Ave., Cambridge	(617) 253-5942
Harvard Museum of Natural History	26 Oxford St., Cambridge	(617) 495-3045
Hull Lifesaving Museum	1117 Nantasket Ave., Hull	(781) 925-5433
Institute of Contemporary Art	100 Northern Ave.	(617) 478-3100
Isabella Stewart Gardner Museum	280 The Fenway	(617) 566-1401
John F. Kennedy Presidential Library and Museum	Columbia Point	(617) 514-1600
MIT Museum	265 Massachusetts Ave., Cambridge	(617) 253-5927
Museum of Fine Arts	465 Huntington Ave.	(617) 267-9300
Museum of Science	1 Science Park	(617) 723-2500
National Center of Afro-American Artists	300 Walnut Ave.	(617) 442-8614
New England Aquarium	1 Central Wharf	(617) 973-5200
Old North Church	192 Salem St.	(617) 523-6676
Paul Revere House	19 North Square	(617) 523-2338
Peabody Museum of Archaeology and Ethnology	11 Divinity Ave., Cambridge	(617) 496-1027
Plimoth Plantation	137 Warren Ave., Plymouth	(508) 746-1622
Rose Art Museum	415 South St., Waltham	(781) 736-3434
Skywalk Observatory at Prudential Center	800 Boylston St.	(617) 859-0648
Society of Arts and Crafts	175 Newbury St.	(617) 266-1810
Trinity Church	206 Clarendon St.	(617) 536-0944
U.S.S. Constitution	1 Constitution Road, Charlestown	(617) 242-5670

Performing Arts

Performing Arts	Address*	Phone**
Boston Ballet (Wang Theatre)	270 Tremont St.	(617) 695-6955
Boston Lyric Opera (Shubert Theatre)	265 Tremont St.	(866) 348-9738
Boston Opera House	539 Washington St.	(617) 259-3400
Boston Symphony Orchestra	301 Massachusetts Ave.	(617) 266-1492
Boston University College of Fine Arts	TheatreLab, 855 Commonwealth Ave.	(617) 933-8600
Boston University Theatre Mainstage	264 Huntington Ave.	(617) 933-8600
Cambridge Multicultural Arts Center	41 Second St., Cambridge	(617) 577-1400
Charles Playhouse	74 Warrenton St.	(617) 426-5225
Improv Asylum	216 Hanover St.	(617) 263-6887
ImprovBoston	40 Prospect St., Cambridge	(617) 576-1253
Jordan Hall	30 Gainsborough St.	(617) 585-1260
Opera Boston (Cutler Majestic Theatre)	219 Tremont St.	(800) 233-3123

DIRECTORY (cont.)

Restaurants and Nightlife	Address*	Phone**
Aujourd'hui	200 Boylston St.	(617) 351-2037
Café Fleuri	250 Franklin St.	(617) 451-1900
Cheers, The Original	84 Beacon St.	(617) 227-9605
Cheers, The Replica	Faneuil Hall Marketplace	(617) 227-0150
Clio	370 Commonwealth Ave.	(617) 536-7200
Hamersley's Bistro	553 Tremont St.	(617) 423-2700
L'Espalier	774 Boylston St.	(617) 262-3023
Legal Sea Foods, Copley Place	100 Huntington Ave.	(617) 266-7775
Legal Sea Foods, Long Wharf	225 State St.	(617) 742-5300
Legal Sea Foods, Park Square	26 Park Plaza	(617) 426-4444
Legal Sea Foods, Prudential Center	800 Boylston St.	(617) 266-6800
Locke-Ober	3 Winter Place	(617) 542-1340
Meritage	70 Rowes Wharf	(617) 439-3995
Mistral	223 Columbus Ave.	(617) 867-9300
No. 9 Park	9 Park St.	(617) 742-9991
Radius	8 High St.	(617) 426-1234
Ryles Jazz Club	212 Hampshire St., Cambridge	(617) 876-9330
Scullers Jazz Club	400 Soldiers Field Road	(617) 562-4111
T.T. The Bear's Place	10 Brookline St., Cambridge	(617) 492-BEAR
Top of the Hub	800 Boylston St.	(617) 536-1775
Troquet	140 Boylston St.	(617) 695-9463
Uni	370 Commonwealth Ave.	(617) 536-7200
Wally's Café	427 Massachusetts Ave.	(617) 424-1408

Sports and Recreation

Boston Red Sox	Fenway Park, 4 Yawkey Way	(877) REDSOX9
Braintree Municipal Golf Course	101 Jefferson St., Braintree	(781) 843-6513
Brookmeadow Country Club	100 Everendon Road, Canton	(781) 828-4444
George Wright Golf Course	420 West St., Hyde Park	(617) 364-2300
Newton Commonwealth Golf Course	212 Kenrick St., Newton	(617) 630-1971
Pinehills Golf Club	54 Clubhouse Drive, Plymouth	(508) 209-3000
Project Bread Walk for Hunger	145 Border St., East Boston	(617) 723-5000
Shaker Hills Golf Course	146 Shaker Road, Harvard	(978) 772-2227
Volvo Ocean Race	Fan Pier, 28 Northern Ave.	(617) 443-9200
William J. Devine Franklin Park Golf Course	One Circuit Drive, Dorchester	(617) 265-4084

*Boston unless otherwise specified.
**10-digit dialing required.

DIRECTORY (cont.)

Shopping and Galleries	Address*	Phone**
Alpha Gallery	38 Newbury St.	(617) 536-4465
Berenberg Gallery	4 Clarendon St.	(617) 536-0800
Boston Sculptors Gallery	486 Harrison Ave.	(617) 482-7781
Brattle Book Shop	9 West St.	(617) 542-0210
Copley Place	2 Copley Place	(617) 369-5000
Downtown Crossing	59 Temple Place	(617) 482-2139
Gallery NAGA	67 Newbury St.	(617) 267-9060
Gurari Collections	91 Charles St.	(617) 367-9800
Hamill Gallery of Tribal Art	2164 Washington St., Roxbury	(617) 442-8204
Harvard Book Store	1256 Massachusetts Ave., Cambridge	(617) 661-1515
Judith Dowling Asian Art	133 Charles St.	(617) 523-5211
Keiko Gallery	121 Charles St.	(617) 725-2888
L'Attitude	218 Newbury St.	(617) 927-4400
Lanoue Fine Art	160 Newbury St.	(617) 262-4400
Martha Richardson Fine Art	38 Newbury St.	(617) 266-3321
Mercury Gallery	8 Newbury St.	(617) 859-0054
Pucker Gallery	171 Newbury St.	(617) 267-9473
Robert Klein Gallery	38 Newbury St.	(617) 267-7997
The Shops at Prudential Center	800 Boylston St.	(617) 236-3100
Vessels Gallery	8 Union Park St.	(617) 424-6700

*Boston unless otherwise specified.
**10-digit dialing required.

CASE REPORT

Multipurpose Use of a Single Mini-Implant for Anchorage in an Adult Patient

MORTEN GODTFREDSEN LAURSEN, DDS
BIRTE MELSEN, DDS, DO

Many adults with extracted posterior teeth do not attach a high priority to prosthetic reconstruction. Failure to replace a missing tooth, however, can lead to changes in occlusal function and migration of adjacent teeth toward the extraction space. The result may be the development of a malocclusion or exacerbation of an existing deviation, necessitating bite rehabilitation. At this stage, optimal reconstruction using either implants or bridges may require preprosthetic orthodontic treatment.

In young patients, growth tends to neutralize vertical development, facilitating orthodontic anchorage. In adult patients with several missing teeth, however, an imbalance between the active and reactive tooth units can result in loss of anchorage, making it impossible to achieve the desired tooth movements. The use of skeletal anchorage with temporary anchorage devices (TADs) can help solve this problem, allowing optimal prosthodontic reconstruction.[1-7]

Careful biomechanical planning is needed to determine how, when, and where the skeletal anchorage should be incorporated into orthodontic treatment.[8] Anchorage problems should not be addressed simply by increasing the number of miniscrews, nor should TADs be used as a crutch to compensate for problems due to poor planning.[8-10] Rather, a strategy should be developed for attaining treatment goals using as few miniscrews as possible, thus minimizing risks, treatment time, and costs while maximizing patient comfort.

This article describes the efficient use of a single mini-implant for several purposes during preprosthetic orthodontic treatment of an adult patient with numerous missing teeth.

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Dr. Laursen


Dr. Melsen

Diagnosis and Treatment Planning

A 47-year-old female was referred by her general dentist for correction of an unfavorable position of the maxillary left second premolar and second molar before prosthetic reconstruction (Fig. 1). The patient wanted reconstruction for improved function and esthetics, as well as space closure and straightening of the anterior teeth.

Some 35 years earlier, both maxillary first premolars had been extracted in association with orthodontic treatment for crowding and excessive overjet. According to the patient, the treatment was interrupted and never completed. The mandibular second molars had been extracted due to caries. The previous extractions and a tooth-size discrepancy between the upper and lower premolars had left spaces distal to both maxillary canines, with the space on the left side measuring 4.5mm. Moreover, endodontic problems had resulted in loss of the maxillary left first molar, leaving 8mm of space between the left premolar and second molar. Therefore, the area of occlusal support on the left side consisted of only the canine, the premolar, and the marginal

Fig. 1 47-year-old female patient with overjet, anterior spacing, and loss of posterior occlusal support due to numerous missing teeth.

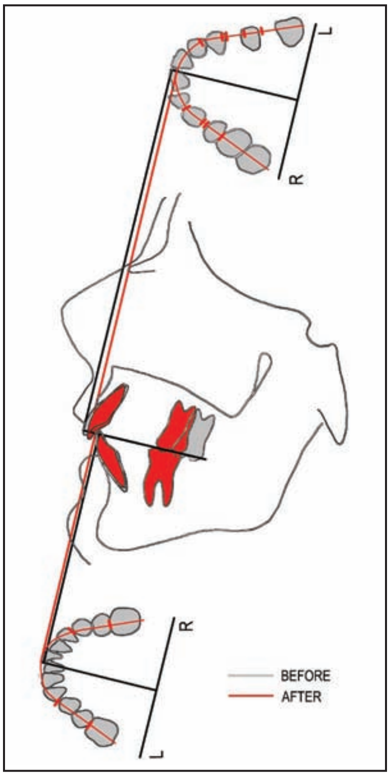


Fig. 2 Visualized Treatment Objective showing projected movement of maxillary left second molar into neutral position of extracted first molar and planned positions of canines and remaining first molars.

ridge of the extruded second molar. All four third molars were also missing. The maxillary dental midline was deviated to the left, and the mandibular anterior segment was crowded.

The primary goal of orthodontic treatment was to position the maxillary left premolar and molar for prosthetic reconstruction with one premolar implant behind the maxillary left canine. The patient would then have full occlusion on two pairs of premolars and one pair of molars on the left side. This plan involved mesial movement of the extruded maxillary left second molar into the neutral position of the extracted first molar, requiring extradental anchorage (Fig. 2). The tooth would be intruded, and space would be created for the implant in the left first premolar region through distal movement of the second premolar. The distal relation of the maxillary and mandibular right first molars and the neutral canine relations would be maintained. Minor spaces would be left distal to both maxillary canines because of the tooth-size discrepancy. The smile would be improved through closure of the anterior diastema, leveling and alignment, and coordination of the dental midlines.

The treatment plan was divided into four phases. Phase I would consist of mesial movement, intrusion, and uprighting of the maxillary left second molar, using a TAD in the maxillary left first premolar region; "hinge mechanics"[11] to guide the maxillary left second molar, with Triad* acrylic gel used to raise the bite

*Registered trademark of Dentsply Caulk, 38 W. Clarke Ave., P.O. Box 359, Milford, DE 19963; www.caulk.com.

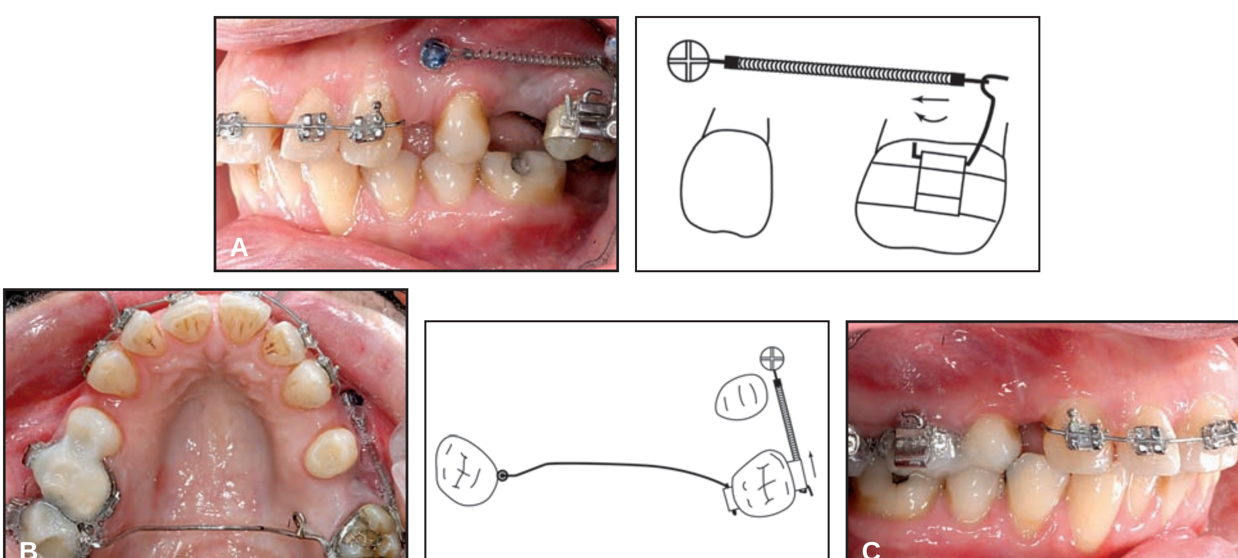


Fig. 3 A. Mini-implant inserted as direct anchorage for mesial movement of maxillary left second molar. B. Transpalatal arch with vertical hinge on lingual of maxillary right second molar used to guide left second molar into planned position. C. Triad* acrylic gel used for temporary bite opening and reinforcement of occlusal anchorage.

Fig. 4 Mini-implant used as direct anchorage for mesial movement and indirect anchorage for intrusion of maxillary left second molar.

and disocclude the tooth; and closure of the anterior diastema. Phase II would involve distal movement of the maxillary left second premolar by reciprocal anchorage between it and the second molar. Phase III would comprise arch coordination and finishing. Phase IV, the retention phase, would include bonding of fixed retainers in the maxillary arch from canine to canine and left second premolar to left second molar and in the mandibular arch from right canine to first premolar; a maxillary splint would also be delivered.

Treatment Progress

An Aarhus Anchorage System** mini-implant (1.5mm in diameter, 11.6mm long) was inserted between the maxillary left canine and premolar to serve as direct anchorage for the mesial displacement of the extruded left second molar, with a Sentalloy*** closed-coil spring attached between the screw and a power arm on the second molar (Fig. 3A). The rotation of the second molar was controlled by hinge mechanics from a transpalatal bar inserted in the horizontal palatal slot of the second molar, with its center of rotation located in a contralateral palatal vertical cylinder on the right second molar (Fig. 3B). Triad was applied to the maxillary right second molar, right first molar, right second premolar, and left second premolar to reinforce the anchorage unit on the right side and to raise the bite slightly, allowing mesial movement of the left second molar (Fig. 3C).

When a primary contact at the left second molar prevented further mesial displacement, an intrusive force was added by means of an .018" × .025" stainless steel segment connecting the premolar bracket to the mini-implant and extending to a one-point contact on the buccal tube of the left second molar (Fig. 4). On the palatal side, a power arm was bonded to the left second premolar and attached to a soldered hook on the hinge with a Sentalloy closed-coil spring to help guide the left second molar mesially. The left second premolar was indirectly anchored to the mini-implant through a step bend in the buccal stainless steel segment.

Instead of undergoing the desired pure translation, however, the left second molar tipped mesially. This tipping was caused by the deep extension of the maxillary sinus into the alveolar process mesial to the second molar; the mini-implant could not be placed in a more apical position because of interference from the buccal ligaments and the power arm on the left second molar. Because of the slight play in both its vertical and horizontal insertions, the hinge could not prevent the tipping.

At this point, the mini-implant took on its third role. A cantilever uprighting spring made of .017" × .025" TMA† wire was inserted in the auxiliary tube of the molar band, activated for mesial root movement of the left second molar, and hooked onto the existing .018" × .025" stainless steel segment, which was anchored to the mini-implant (Fig. 5A). This stainless steel seg-

**MEDICON eG, Tuttlingen, Germany; www.medicon.de. Distributed by American Orthodontics, 1714 Cambridge Ave., Sheboygan, WI 53082; www.americanortho.com.

***Registered trademark of GAC International, Inc., 355 Knickerbocker Ave., Bohemia, NY 11716; www.gacintl.com.

†Registered trademark of Ormco/“A” Company, 1717 W. Collins Ave., Orange, CA 92867; www.ormco.com.

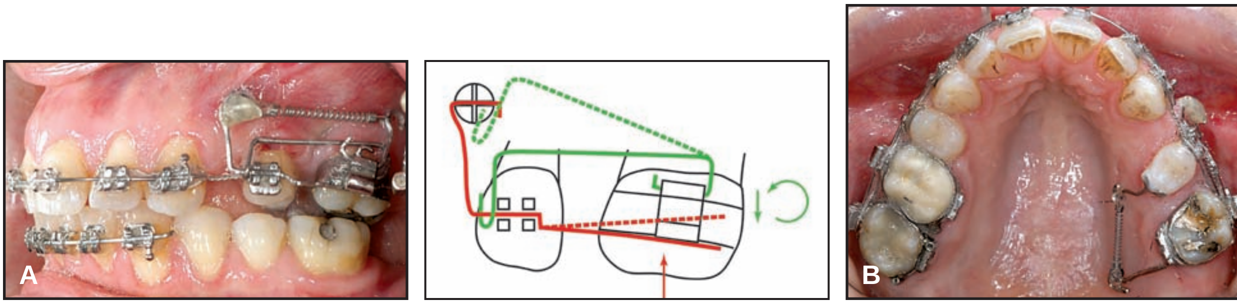
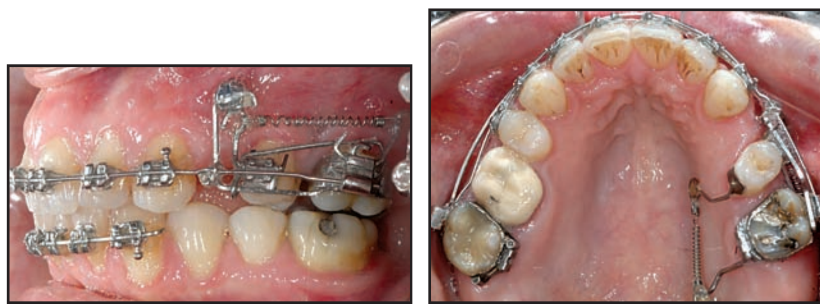


Fig. 5 A. Simultaneous mesial movement, intrusion, and uprighting of maxillary left second molar. Uprighting spring is attached to indirect anchorage segment, which also counteracts extrusive force on left second molar generated by uprighting moment. B. Transpalatal arch removed, and power arm added to molar for mesial movement and rotational control.

Fig. 6 Final closure of space between left second premolar and second molar with reciprocal anchorage and continued uprighting against indirect anchorage segment, modified to bypass premolar.



ment counteracted the vertical side effects of molar extrusion and premolar intrusion that were generated by the uprighting spring. The palatal hinge was removed to allow for the uprighting. In its place, power arms attached to the left second premolar and second molar were connected by a Sentalloy closed-coil spring for mesial movement and rotational control of the left second molar (Fig. 5B). The step bend in the buccal .018" × .025" stainless steel segment prevented distal movement of the left second premolar.

During the finishing phase, the left second premolar was moved distally with reciprocal anchorage against the left second molar, using Sentalloy closed-coil springs attached to power arms on the two teeth both buccally and lingually (Fig. 6). The .018" × .025" stainless steel segment was modified, bypassing the left second premolar to allow for the distal movement.

After 20 months of treatment, the orthodontic aims had been achieved. The mini-implant was removed, and a Brånemark implant‡ was placed in the left first premolar region during the finishing phase, three months before debonding. Six months later, the implant crown was cemented. In addition to bonded upper and lower lingual retainers, a fixed labial retainer wire was placed between the maxillary left second premolar and left second molar to prevent space reopening. A 2mm removable acrylic splint was also delivered, to be worn full-time for the first three months and at night only for the following 24 months.

The final post-treatment radiographic records clearly show the molar displacement, because amalgam had been left in the extraction space to serve as a reference (Fig. 7). Small spaces remained distal to the maxillary canines because of the tooth-size discrepancy between the upper and lower premolars. The total treatment time was 23 months, including 15 months of mesial movement, intrusion, and uprighting of the left second molar. After debonding, excess gingival tissue mesial to the left second molar was excised, and the amalgam

‡Registered trademark of Nobel Biocare, P.O. Box CH-8058, Zürich-Flughafen, Switzerland; www.nobelbiocare.com.

Fig. 7 Significantly improved smile esthetics and occlusal support after 23 months of orthodontic treatment and placement of prosthodontic implant in left first premolar region.

molar filling was replaced to achieve optimal morphology and occlusion.

Discussion

A mini-implant with a bracket-like head, as used in this patient, can provide both direct and indirect anchorage. The required movement of the maxillary left second molar could not be achieved with a single force acting directly on the mini-implant. First, the screw was used as direct anchorage, assisted by a palatal hinge to guide the left second molar. Later, the connection of the mini-implant to the premolar provided indirect anchorage for an intrusive force on the buccal side of the molar and a mesially directed force on the lingual aspect. Finally, the wire connecting the premolar to the mini-implant was used as anchorage for an uprighting spring, while its extension served to neutralize the extrusive force generated by the spring.

The case shown here demonstrates that a single skeletal anchorage unit can generate a variety of different force systems. Achieving the desired treatment goals, however, requires precise definition of the forces required. Thus, the use of skeletal anchorage actually increases, rather than reduces, the need for careful biomechanical planning.

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