Ideal Appliance Placement with APC Brackets and Indirect Bonding

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Today's orthodontic appliances are engineered to minuscule tolerances, with tip, torque, and rotation measured in increments of single degrees, using powerful technical equipment and computer-aided design. Yet many practitioners apply brackets to the teeth indiscriminately—whether directly in the patient's mouth or on a set of indirect casts—and defeat the purpose of the appliance prescription.

To take full advantage of the features designed into an appliance, we must have an accurate and reliable bracket-placement system. Using the center of the tooth as a reference point[1] will not necessarily align the teeth if, for instance, one central incisor is a little longer than the other. Therefore, in my opinion, the functional and esthetic surfaces of the teeth should be our points of reference.

The system I will describe in this article, using Unitek MBT Adhesive Precoated (APC*) brackets, can produce high-quality results—in terms of alignment, marginal ridge levels, buccolingual inclination, occlusal relationship, occlusal contact, overjet, interproximal contacts, and root angulation[2]—as a matter of daily routine. Bracket placement can be accomplished in a few minutes of clinical time. In fact, it is not uncommon in my office to have an ideally placed, indirect-bonded setup, from second molar to second molar, in place (including wires) in less than 30 minutes. This is accomplished with no patient discomfort and a minimum of doctor time. The process is simple to learn, extremely accurate, and reliable, and most of the steps can be easily delegated.

*Registered trademark of 3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016.

Indirect Bonding Technique

At one time, I banded the first and second molars and then indirect-bonded from second bicuspid to second bicuspid in any full-treatment, full-appliance case. Recently, however, I have begun bonding from second molar to second molar unless I need molar bands for a headgear, transpalatal arch, or other cross-arch appliance. I have used full-arch indirect bonding successfully in all kinds of cases, including nonextraction, extraction, and surgical-orthodontic.

The first molar slot is the starting point for

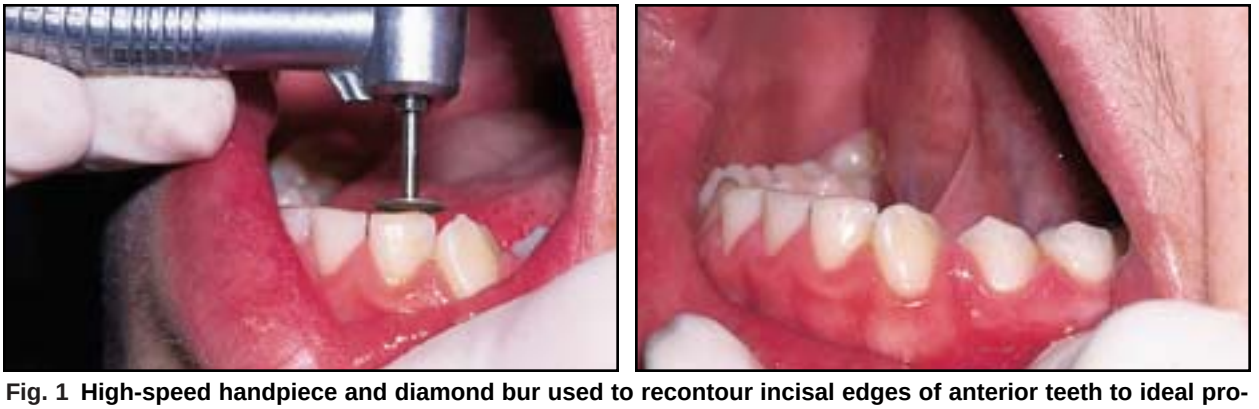

Fig. 1 High-speed handpiece and diamond bur used to recontour incisal edges of anterior teeth to ideal proportions.

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TABLE 1
ARMAMENTARIUM FOR INDIRECT BONDING

Laboratory	Clinical
Dental stone	High-speed handpiece
Vacuum mixer	Brasseler #817-065
Plaster bowl and spatula	Slow-speed handpiece and prophy cup
Pentel .03mm black lead	Pumice
Pentel .05mm red lead	Alginate and Alginator II
Separating agent	Dappen dish
Small paintbrush	Cotton pliers
Unitek MBT APC brackets	Sponge pellets
Half-Hollenbeck	Nola Dry Field System
Millimetric probe	High-speed and slow-speed evacuation
Triad 2000 light-curing unit	Air/water syringe
Exaflex VHV Putty	37% phosphoric acid
Mixing bowl and warm water	Unitek Transbond MIP
Bard-Parker knife	Unitek Sondhi Rapid-Set IDB Adhesive
Microetcher with 50-micron aluminum oxide	Second timer
Acetone and sponge pellets	
Toothbrush	

placing the remaining bracket slots. If banding the molars, seat the molar bands *level* with the marginal ridges. Do not overseat the molar bands, as this will result in the bracket slots being placed too far gingivally.

The incisal edges—the esthetic surfaces—of the anterior teeth should be the reference points for bracket placement. Therefore, after cementing the molar bands, I equilibrate and recontour the anterior incisal edges to ideal proportions using a high-speed handpiece and a Brasseler #817-065 diamond bur** (Fig. 1, Table 1). I used to estimate where the bracket should be ideally placed and then recontour after alignment, but I have found it easier, and much more accurate, to recontour first. A series of articles by Kokich is an excellent reference for tooth recontouring.[3-5]

If necessary, clean the teeth with a prophy cup and pumice. Take accurate alginate impressions with mechanically spatulated alginate (Alginator II***). Pour the impressions with vacuum-mixed stone, not plaster. Rough-trim the casts enough to allow visualization of the teeth, then let them dry thoroughly.

Using a thin black lead pencil (Pentel .03mm), draw vertical lines on the cast indicating the long axes of the teeth from the crowns to the positions of the roots (Fig. 2A). Using a thin red pencil (Pentel .05mm) for contrast, draw lines connecting the mesial and distal marginal ridges of the first bicuspids, then do the same for the

**Brasseler USA, 800 King George Blvd., Savannah, GA 31419.

***Great Lakes Orthodontics, Ltd., 199 Fire Tower Drive, Tonawanda, NY 14150.

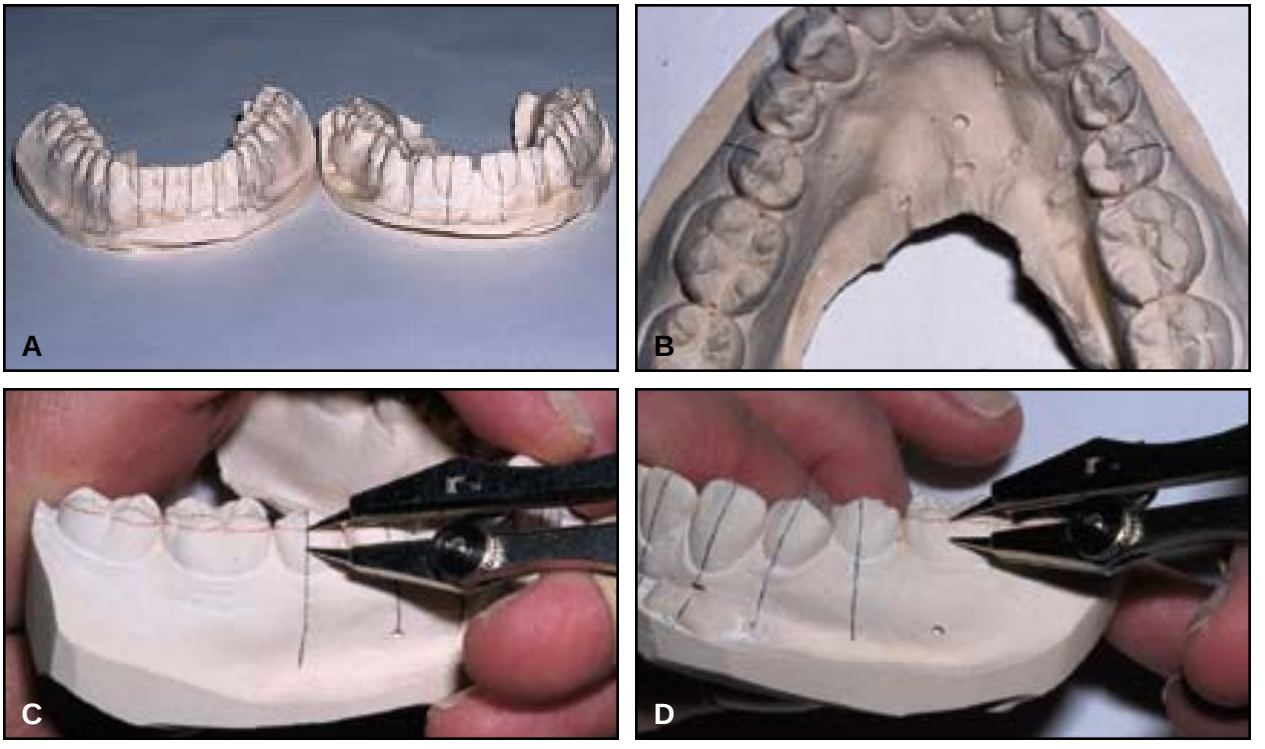

Fig. 2 A. Thin black lead pencil used to indicate long axes of teeth. B. Thin red pencil used to connect mesial and distal marginal ridges of first and second bicuspids. C. Distance from edge of molar band to slot transferred to bicuspids. D. When bonding molars, molar bracket slot line placed 2-2.5mm below line connecting marginal ridges as reference for bicuspids.

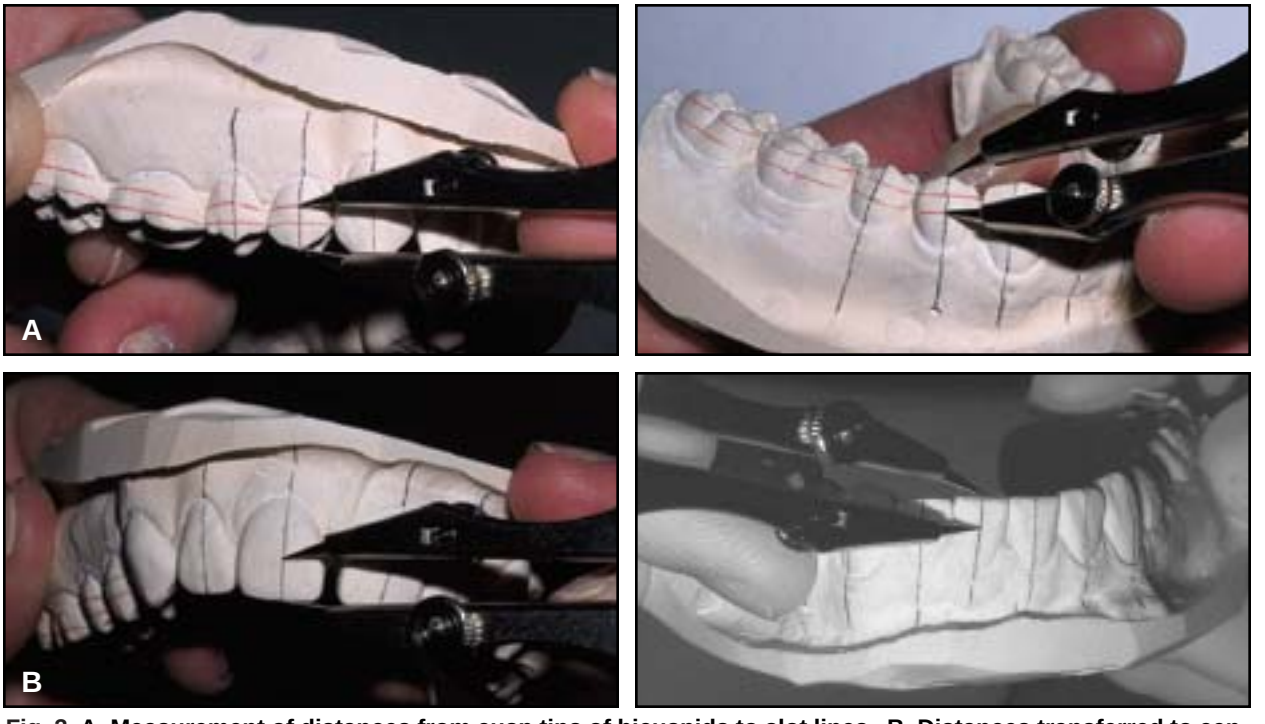

Fig. 3 A. Measurement of distances from cusp tips of bicuspids to slot lines. B. Distances transferred to central incisors.

second bicuspids (Fig. 2B).

In each quadrant, measure the distance from the edge of the molar band to the slot, and transfer this distance to the bicuspids by adding lines below the marginal ridge lines (Fig. 2C). Alignment of these slot lines for the bicuspids with those of the molars will align the marginal ridges of the maxillary teeth and place the functional cusp tips of the mandibular teeth on a level plane. If bonding the molars, place the molar slot lines 2-2.5mm below the lines connecting the marginal ridges, and use these as the reference lines for the bicuspids (Fig. 2D).

Measure the distance from the cusp tip of the bicuspid to the slot line, and transfer this distance to the central incisor (Fig. 3A). The maxillary measurement should be about 4.5mm, and the mandibular measurement about 4mm (Fig. 3B). To open the bite, reduce these distances; to close the bite, increase them.

For the maxillary lateral incisors, reduce the slot distance by .5mm (Fig. 4A). For the maxillary canines, increase the distance by 1mm (Fig. 4B). The mandibular incisor slots should be placed on the same level as the bicuspid slot line, while the mandibular canine slot distance should be increased by 1mm (Fig. 4C). These predefined slot positions will allow a predictable expression of torque, tip, and rotation as prescribed by the appliance (Fig. 4D).

Apply two coats of separating agent to the casts, and let them dry. An assistant can then place the APC brackets in the marked positions on the casts (Fig. 5). I have found that if all the flash is removed at the time of bracket placement, it is not necessary to store the casts in a dark area until they are checked by the doctor. When I adjust the bracket positions, I use a half-Hollenbeck instrument to check slot alignments and an incremental probe as a guide for the

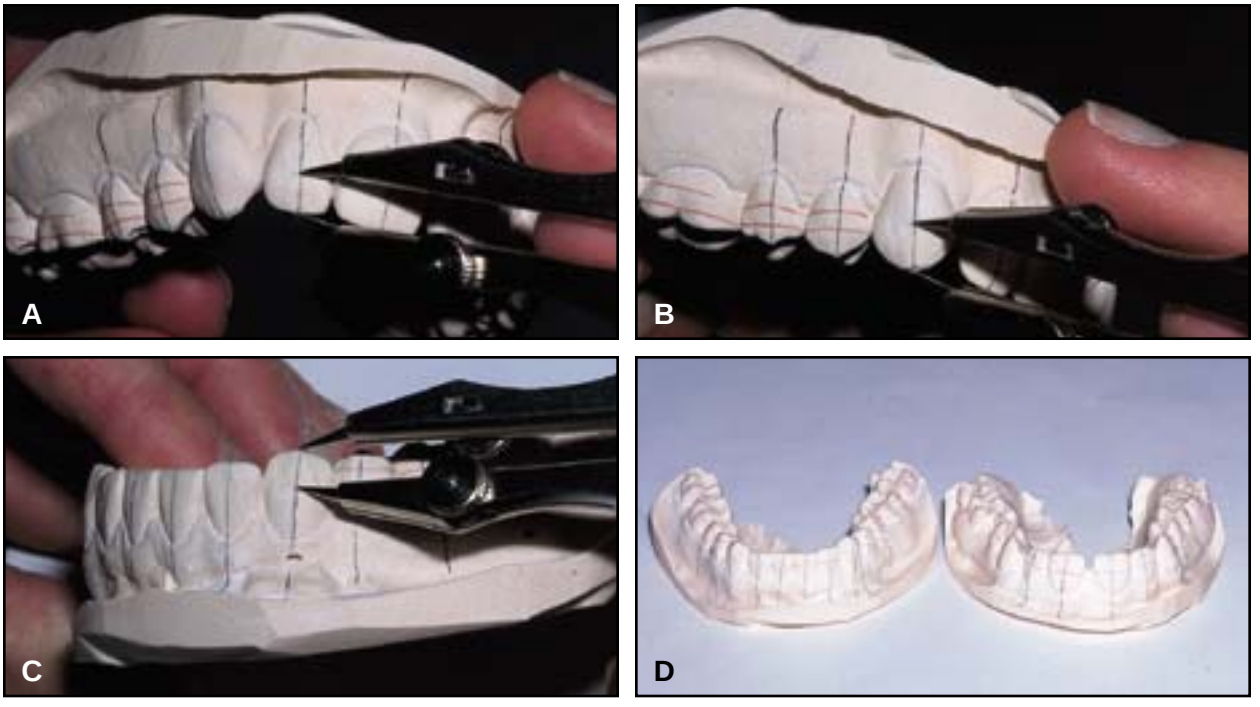

Fig. 4 A. Bicuspid slot distance reduced by .5mm for maxillary lateral incisors. B. Slot distance increased by 1mm for maxillary canines. C. Mandibular canine slot distance increased by 1mm. D. Finished markings on casts.

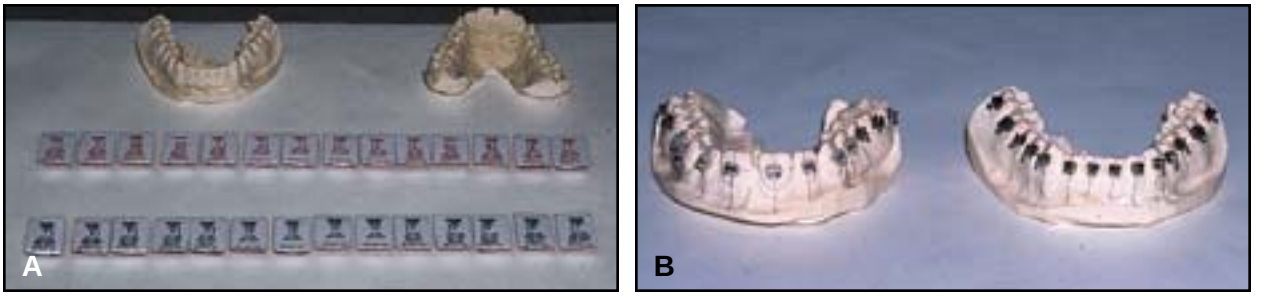

Fig. 5 A. Setup of APC brackets. B. Brackets placed in marked positions on casts by assistant.

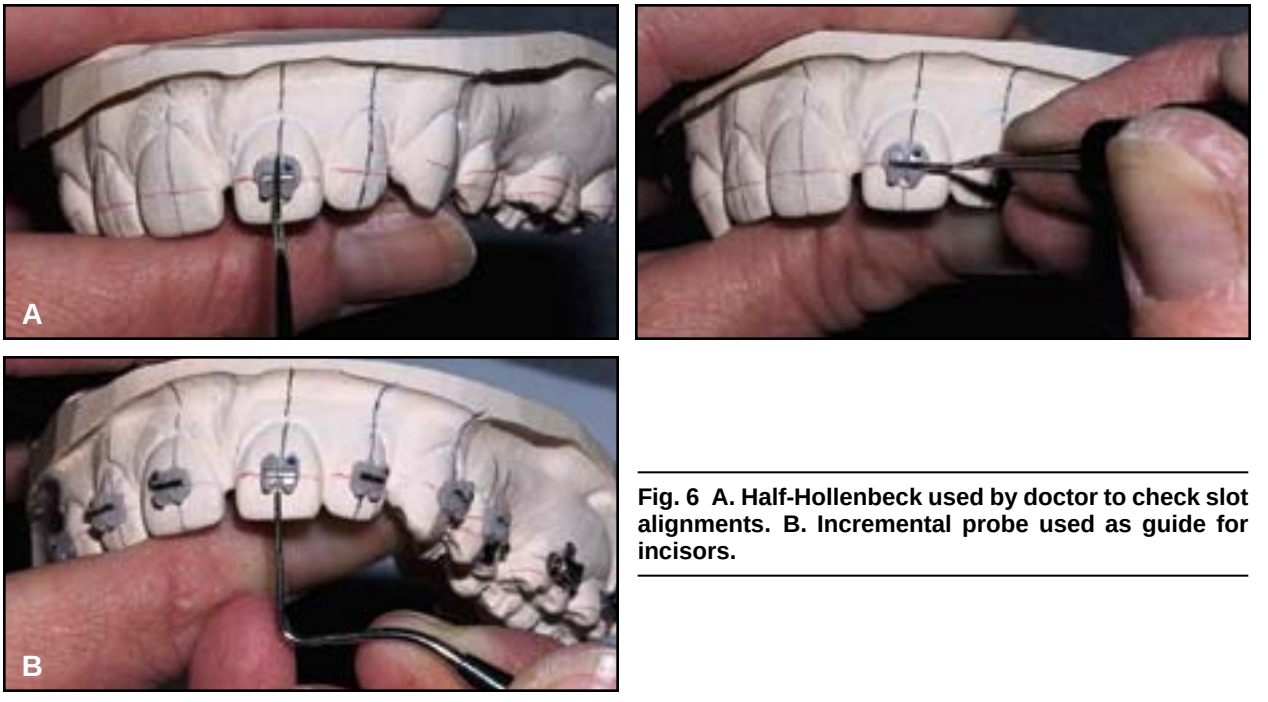

Fig. 6 A. Half-Hollenbeck used by doctor to check slot alignments. B. Incremental probe used as guide for incisors.

incisors (Fig. 6).

After the doctor has checked the casts, place each one in a Triad 2000† light-curing unit for four minutes (Fig. 7). Make the custom transfer trays from Exaflex‡ Very High Viscosity Putty (Fig. 8). It is important that the trays be thick enough for adequate rigidity, and that they cover the occlusal surfaces of the teeth to provide positive seating.

Once the trays have hardened, place the casts in a bowl of warm water and let them soak for 20 minutes. Remove each tray from its cast, then place it immediately in the Triad unit for one minute with the brackets facing upward. Clean the trays with tap water and a clean toothbrush.

Microetch the custom bracket bases very lightly with 50-micron aluminum oxide†† (Fig. 9), rinse them in tap water, and clean them with cotton pellets soaked in acetone.

†Registered trademark of Dentsply International Inc., York, PA 17405.

‡Registered trademark of GC America, Inc., 3737 W. 127th St., Chicago, IL 60658.

††Microetcher, registered trademark of Danville Engineering, 1901 San Ramon Valley Blvd., San Ramon, CA 94583.

Fig. 7 Cast placed in Triad 2000 light-curing unit.

Fig. 8 Custom transfer trays made from Exaflex Very High Viscosity Putty.

Trim the trays with a Bard-Parker or Exacto knife, making them of equal thickness buccolingually and occlusogingivally (approximately 7mm). Each tray should be trimmed to the level of the brackets on the facial side, and just over the lingual cusps. Remove any areas inside the tray that could interfere with seating. Cut an index mark in each tray to indicate the midline (Fig. 10).

Despite recent suggestions that there is no need to perform prophylaxis prior to bonding,[6] I believe clean enamel is a key to consistent bond strength. There must be a distinction between experimentally acceptable bond strengths and what is best for the patient. Also, without examining the tooth surface under a scanning electron microscope, how do we know it is free of pellicle, plaque, and calculus? The idea of trapping plaque or calculus under composite for two years or longer does not seem appealing to me. Therefore, we always use pumice slurry in a prophy cup to clean all the surfaces to be bonded.

Fig. 9 Bracket bases microetched lightly with 50-micron aluminum oxide.

Fig. 10 Index mark cut in each tray to indicate midlines.

Fig. 11 Nola Dry Field System used for isolation.

Fig. 12 Transbond Moisture Insensitive Primer used to prevent moisture contamination of posterior teeth.

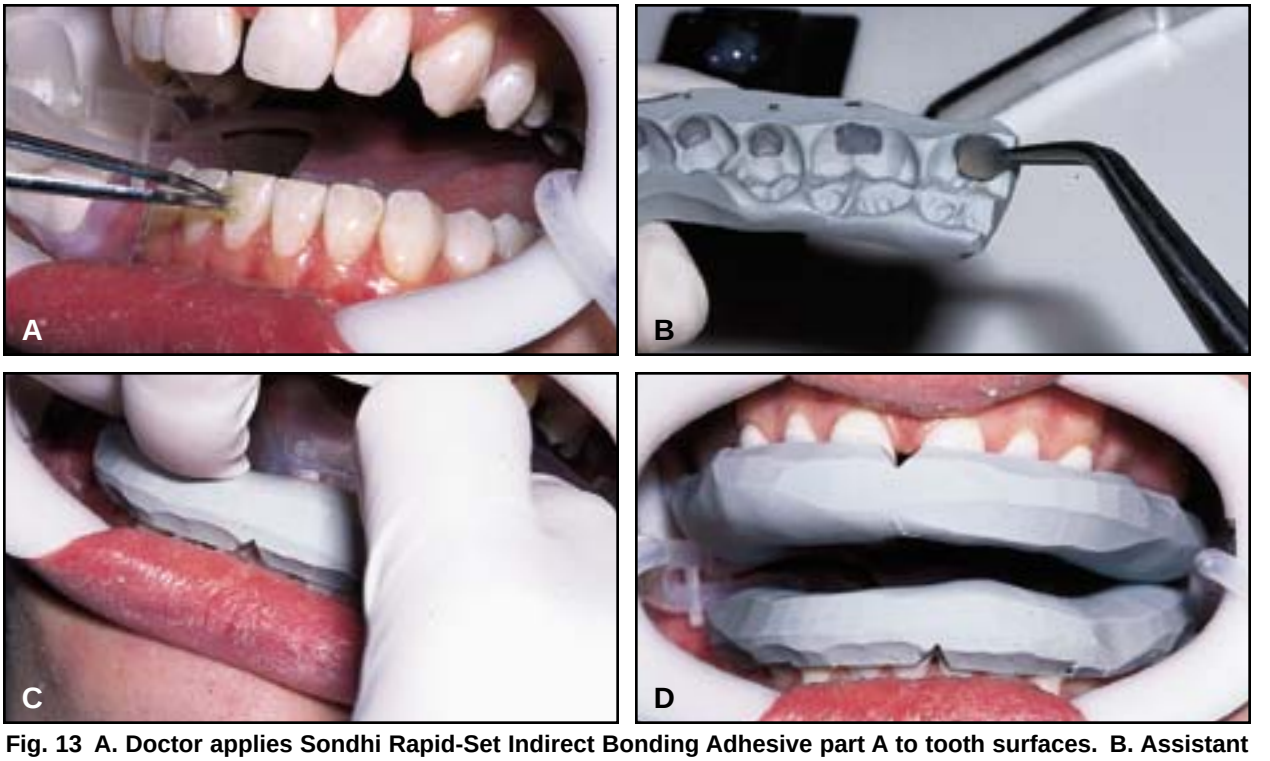

Fig. 13 A. Doctor applies Sondhi Rapid-Set Indirect Bonding Adhesive part A to tooth surfaces. B. Assistant applies adhesive part B to bracket bases in transfer tray. C. Lower tray seated and held in place for 30 seconds. D. After seating upper tray and holding it for 30 seconds, both arches allowed to cure for additional two minutes.

After experimenting with several isolation systems, we have found the Nola Dry Field System‡‡ to be the best (Fig. 11). It is available in adult and child sizes, and can be used to isolate particular sections as well as an entire arch.

Etch with 37% phosphoric acid for 60 seconds,[7] and rinse thoroughly. Since moisture contamination is the primary cause of bond failure, we dry the teeth completely and then place Transbond Moisture Insensitive Primer (MIP*)

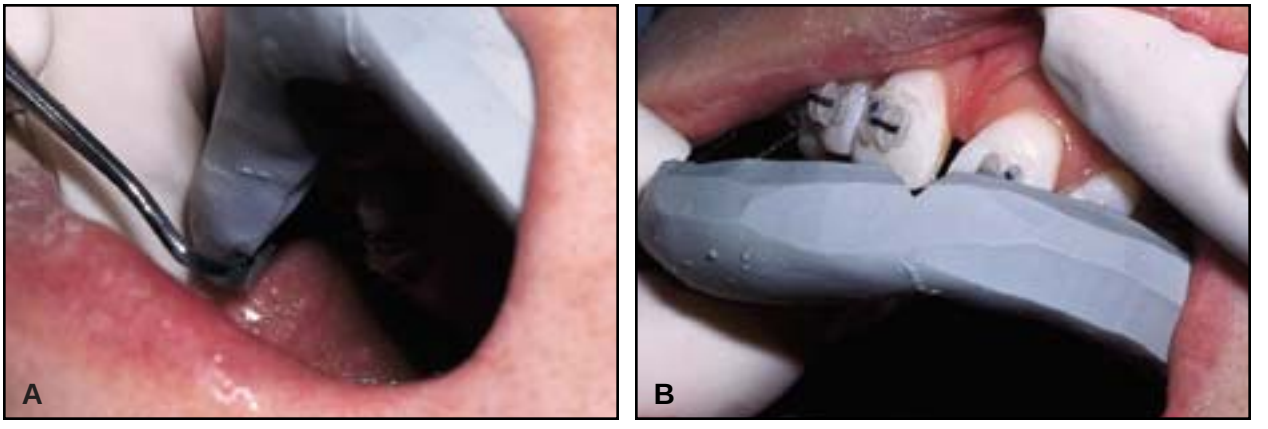

Fig. 14 A. Tray removed by placing scaler under distocclusal edge on patient's right side. B. Tray peeled off from gingival to occlusal in one continuous motion.

Fig. 15 A. Adhesive remaining on bonded tooth surfaces. B. After removal of excess adhesive with scaler. C. Archwires in place.

on the first and second molars, and occasionally on the mandibular second bicuspids (Fig. 12).

While the doctor applies a layer of Sondhi Rapid-Set Indirect Bonding Adhesive* part A to the teeth (Fig. 13A), the assistant applies part B to the bracket bases in the transfer tray (Fig. 13B). Seat the lower tray first, using a continuous motion and gentle pressure, and hold it in place for 30 seconds (Fig. 13C). Bond the maxillary arch in the same manner, and allow both arches to cure for an additional two minutes (Fig. 13D).

Remove each tray by placing a scaler under the distocclusal edge on the patient's right side (Fig. 14A) and peeling from gingival to occlusal. Working from one side of the arch to the other, peel off the tray in one continuous motion (Fig. 14B).

Remove any remaining adhesive with a scaler (Fig. 15A,B). Pay particular attention to adhesive that has been expressed onto the lingual of the incisors, and interproximally and distal to the second molars. Place the archwires (Fig. 15C), and give the patient any necessary care instructions.

We initially used a two-part, chemically cured composite for our custom bases, and we later tried a thermally cured composite. Both of these techniques required placing composite on the brackets, which took a considerable amount of lab time. The advantage of the APC brackets is that they already contain the composite.

‡‡Nola Specialties, Inc., P.O. Box 24129, Hilton Head Island, SC 29925.

*Registered trademark of 3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016.

Fig. 16 A. 20-year-old female with retained deciduous maxillary right canine, impacted permanent maxillary right canine, and anterior crossbite after indirect bonding of APC brackets. Note absence of 2nd- and 3rd-order archwire bends. B. Eruption and alignment of impacted canine after 11 months of treatment.

Scheduling

Indirect bonding offers significant rewards in terms of quality of care and efficiency of treatment (Fig. 16). The essence of indirect bonding is accurate and reliable bracket placement, coupled with the efficient use of doctor time. However, as with any clinical procedure, its usefulness is greatly diminished if it is not scheduled and executed properly. Because of the technical nature of indirect bonding, and because it is seldom used by most practitioners,[8] proper planning and scheduling can be frustrating and even overwhelming.

As Bud Schulman has said, "The magic dimension (of success) is the measure of doctor time per treatment procedure relative to total chair time."[9] In other words, we increase our productivity in an inverse relationship to the amount of doctor time spent on any given task. To appoint patients properly, we need to know how much total chairtime is required for each procedure.[10,11] We can then "schedule like things at like times" to maximize our efficiency.[12]

I did a study of the time it took the doctor and the assistant to perform all the subprocedures related to a full maxillary and mandibular second-molar-to-second-molar indirect bonding (Table 2). These times are what I would consider the minimum for each step; they can, of course, be modified depending on the skills and experience of the practitioner and the supporting staff. They can also be adjusted proportionately for less-than-full setups.

In analyzing our indirect-bonding procedure times, several things became evident:

1. Patient chairtime is minimized.
2. Doctor chairtime is minimized.
3. Assistant utilization is maximized.
4. Procedures become routine and systematized (enhancing "appliance accuracy").
5. The time necessary for execution of procedures is quantified.
6. Scheduling becomes precise, orderly, and predictable.

My office schedule is based on hours divided into six 10-minute intervals. Of a total of 115 appointment procedures, 12 are related to indirect bonding (Table 3). In accordance with the concept of "like things at like times", we allocate a block of time from 9-11:30 a.m. for Appliance Placement Procedures. We typically perform two or three indirect bondings (in addition to other appliance placement procedures) every day, uti-

TABLE 2
TIME STUDY OF SUBPROCEDURES IN FULL-ARCH INDIRECT BONDING

Doctor time:	
1. Equilibrate and recontour teeth	40 seconds
2. Place reference marks on casts	6 minutes
3. Check brackets on casts	3 minutes, 30 seconds
4. Check clean-up of brackets on teeth	30 seconds
5. Check wire placement	10 seconds
6. Prepare and seat upper tray	1 minute, 45 seconds
7. Prepare and seat lower tray	1 minute, 10 seconds
TOTAL	13 minutes, 45 seconds
Assistant time:	
1. Prophy teeth and take impressions	7 minutes
2. Pour impressions	3 minutes
3. Separate impressions and trim casts	3 minutes
4. Apply separating medium	45 seconds
5. Place brackets	12 minutes, 30 seconds
6. Cure composite	10 minutes
7. Form transfer trays	2 minutes, 30 seconds
8. Separate, clean, and trim trays	6 minutes, 30 seconds
9. Prophy, isolate, and etch teeth	4 minutes, 45 seconds
10. Remove trays and clean up	5 minutes, 30 seconds
11. Place wires	4 minutes, 15 seconds
TOTAL	59 minutes, 45 seconds
Total chairtime:	
1. Equilibrate and recontour teeth	40 seconds
2. Prophy teeth and take impressions	7 minutes
3. Prophy, isolate, and etch teeth	4 minutes, 45 seconds
4. Seat upper tray	1 minute, 45 seconds
5. Seat lower tray	1 minute, 15 seconds
6. Remove trays and clean up	5 minutes, 30 seconds
7. Place wires	4 minutes, 15 seconds
TOTAL	25 minutes, 10 seconds

lizing three assistants and six chairs. Of course, the number of indirect-bonding procedures that can be performed will vary depending on the size of the operatory, the number of staff members, and the number of patients.

Staff Management

Colleagues who have used direct bonding for any length of time are typically reluctant to switch to indirect bonding—although they all tell me that, in principle, it sounds like a great procedure. I think their reluctance is based on resistance to change on the part of both doctors and staff members.

The doctor and the staff need to be sold on the concept of indirect bonding and give it enough time to prove its worthiness. Before trying indirect bonding, I suggest calling a staff meeting to describe the procedure and discuss its

advantages. The staff must be convinced that this state-of-the-art technology will result in better treatment, with less chairtime and less stress.

I strongly recommend making a commitment to a minimum of 10 consecutive cases. Trying only one or two cases will result in frustration and contempt for the technique. From my 10 years of experience, I can unequivocally say that once the learning curve has been passed, the results are guaranteed. The simplicity, accuracy, and methodical nature of indirect bonding will make the office run smoother and generate a more pleasant and satisfying environment.

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TABLE 3
APPOINTMENT PROCEDURE LIST FOR INDIRECT BONDING

Procedure	Time Allocation (minutes)
Separation	10
Separation and impression(s)[1]	20
Impression(s) for indirect bonding	20
Banding and indirect bonding	40
Banding, headgear, and indirect bonding	50
Banding upper *or* lower first molars	30
Banding upper *and* lower first *or* second molars	60
Banding upper *and* lower first *and* second molars	90
Indirect bonding upper *and/or* lower incisors[2]	30
Indirect bonding upper *and/or* lower:	
Canine to second bicuspid	40
Indirect bonding upper *or* lower[3]:	
Second bicuspid to second bicuspid	50
First molar to first molar	50
Indirect bonding upper *and* lower:	
Second bicuspid to second bicuspid	60
First molar to first molar	60
Second molar to second molar	60

Notes:

1. In appropriate cases, we place separators and take an impression for indirect bonding at the first appointment, then band the maxillary first molars, fit a headgear, and bond the maxillary anterior teeth at the second appointment. For a maxillary 2 x 4 or 2 x 6, we place separators on the maxillary first molars (if bands are to be used) and take an impression for indirect bonding at the first appointment, then band the first molars and bond at the second appointment.

2. We frequently begin treatment with brackets on the maxillary and mandibular anterior teeth, then indirect-bond from canines to second bicuspids as a second stage of treatment.

3. The procedures for indirect bonding from second bicuspid to second bicuspid, first molar to first molar, and second molar to second molar are exactly the same, and therefore, so are the times.