The Ray Set: A New Technique for Precise Indirect Bonding

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The built-in corrections of the Straight-Wire Appliance* designed by Andrews[1] were based on average tooth dimensions; they did not consider individual variations in tooth morphology, whether congenital or due to restorations or occlusal wear. These variations and other problems such as crowding may compromise the intended results when standard preadjusted brackets are bonded directly. Even minor discrepancies in bracket placement can lead to significant changes in all three planes of space.[2,3]

The influence of variations in tooth surface morphology was first addressed by Kurz and colleagues, who developed indirect bonding for lingual orthodontics.[4] Subsequently, indirect-bonding techniques have been introduced for labial brackets as well.

Indirect bonding can neutralize the influence of variations in vertical bracket positioning on 1st-order corrections and of root deviations on

*Trademark of Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867.

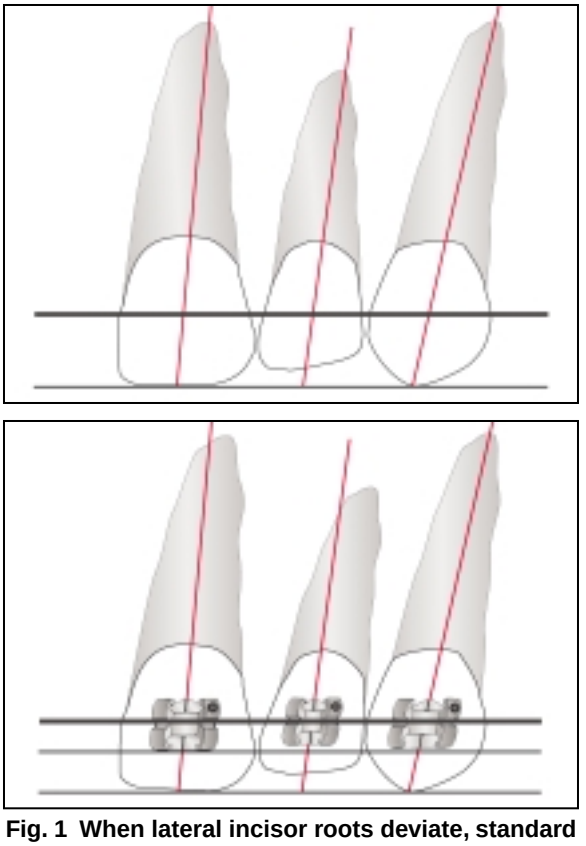

Fig. 1 When lateral incisor roots deviate, standard preadjustedi brackets cannot make proper 2nd-order adjustments.

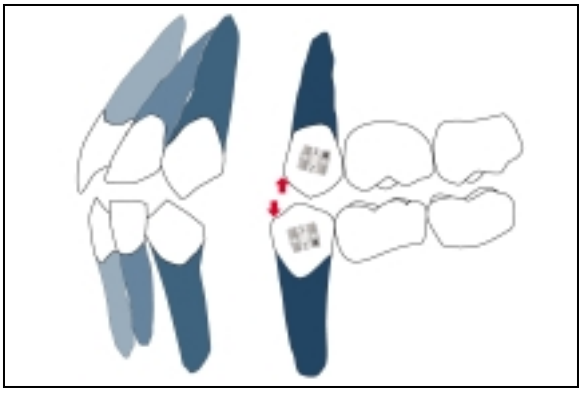

Fig. 2 Tip values modified for anchorage in extraction case.

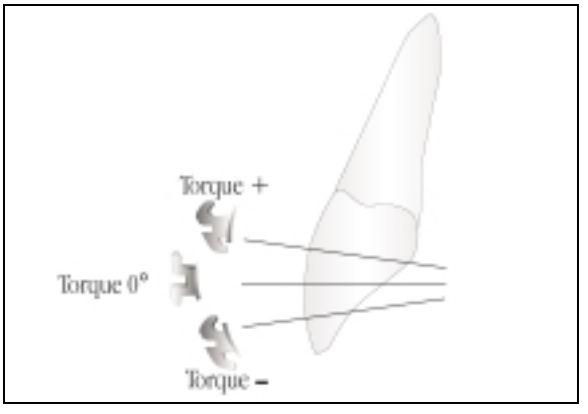

Fig. 3 Relationship between torque and labial convexity of tooth surface.

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2nd-order corrections (Fig. 1). Moreover, the bracket prescriptions can be modified according to anchorage needs by altering the torque or tip on single teeth or groups of teeth (Fig. 2).

Most indirect-bonding techniques require the use of a diagnostic setup. This can be a time-consuming process,[5] although several authors have suggested ways to overcome it.[6,7] The present article describes a new system, the Ray Set,** which has been designed to provide maximum precision in indirect bonding without a diagnostic setup.

The Ray Set enables the clinician to bond preadjusted brackets so the results reflect their prescribed values, regardless of any variations in bracket height and shape of individual teeth. As a result, once a full-size wire is inserted, the labial surfaces will be subjected to the desired 1st,-2nd-, and 3rd-order corrections without the need for finishing adjustments (Fig. 3). As with Targ,* the lingual indirect-bonding system developed by Kurz and colleagues in collaboration with Ormco,* the Ray Set system is able to compensate for anatomical deviations by modifying the bracket bases with bonding adhesives.

*Biaggini Medical Devices, SRL, Viale San Bartolomeo 105, 19126 La Spezia, Italy. Developed in conjunction with Artiglio SNC, Parma, Italy.

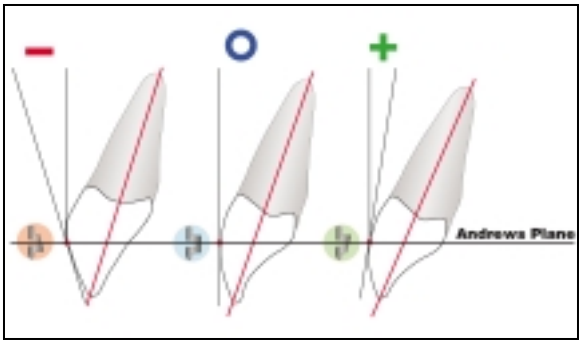

Fig. 4 Torque value is 0 when tangent to labial surface is perpendicular to Andrews Plane.

Torque and Tip Calculations

The bracket position along the tooth's long buccal axis is called Q point. Torque is defined as the angle formed by a vertical line perpendicular to the occlusal plane passing through Q point and a line tangent to the labial surface. The torque value is 0 when this tangent is perpendicular to the *x*-axis (the Andrews occlusal plane) of the coordinate system (Fig. 4). The Ray Set calculates 0 torque by inclining the tooth until the tangent coincides with the vertical line centered on Q point. Starting from 0 torque, it is then possible to evaluate whether the torque in the preadjusted bracket is sufficient to achieve correct buccolingual root inclination, or whether it is necessary to customize the torque by adding composite at the base of the bracket.

The same principle is used to identify the ideal tip for individual teeth. The tip value is 0 when the long axis of the tooth coincides with the vertical line of the coordinate system (Fig. 5). As with torque, the correct tip value is compared with that of the preadjusted bracket. If necessary, the system helps modify tip accordingly.

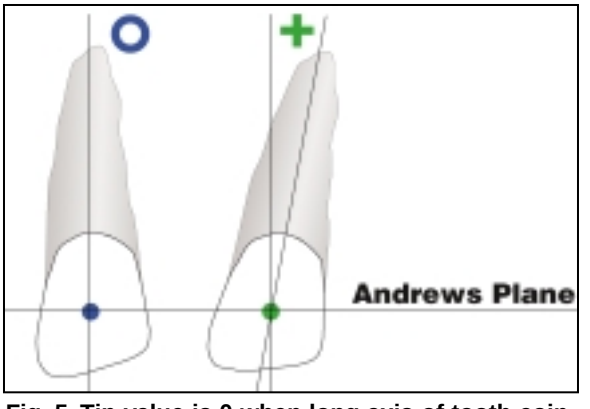

Fig. 5 Tip value is 0 when long axis of tooth coincides with vertical line perpendicular to Andrews Plane.

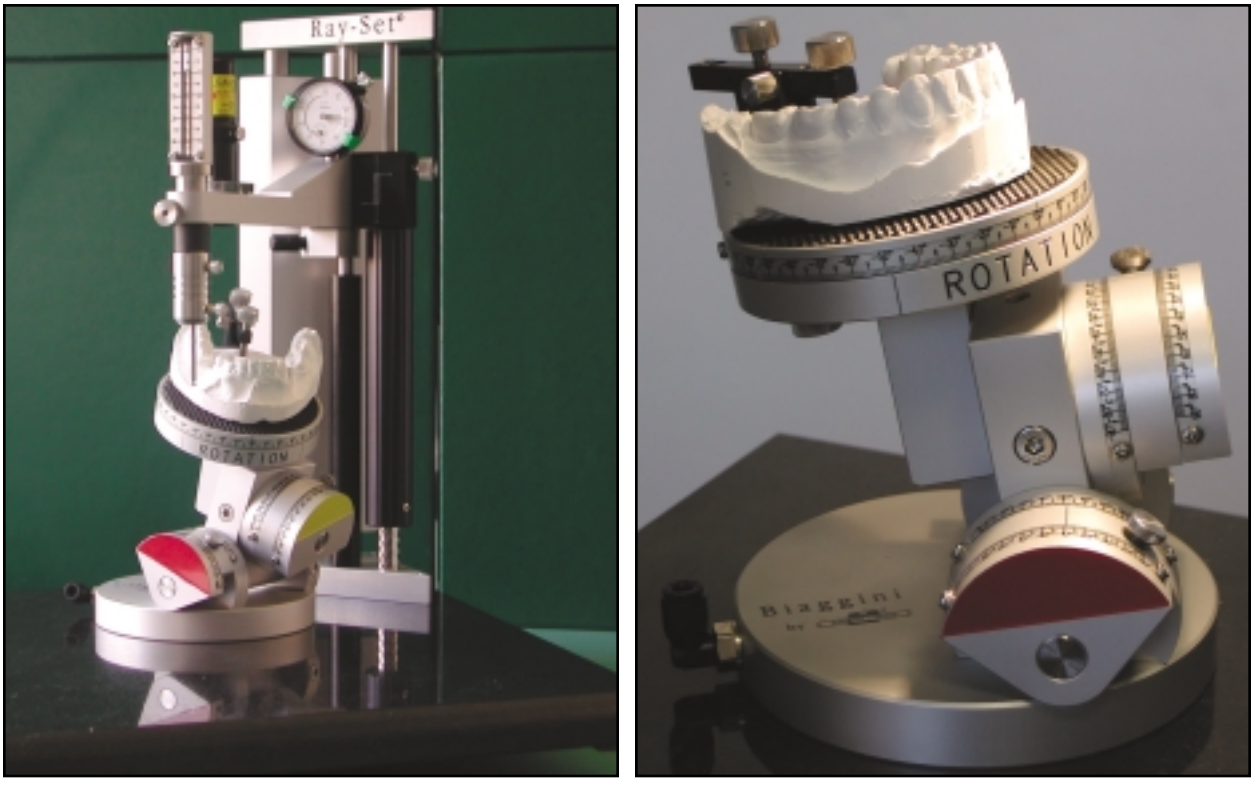

Fig. 6 Ray Set system.

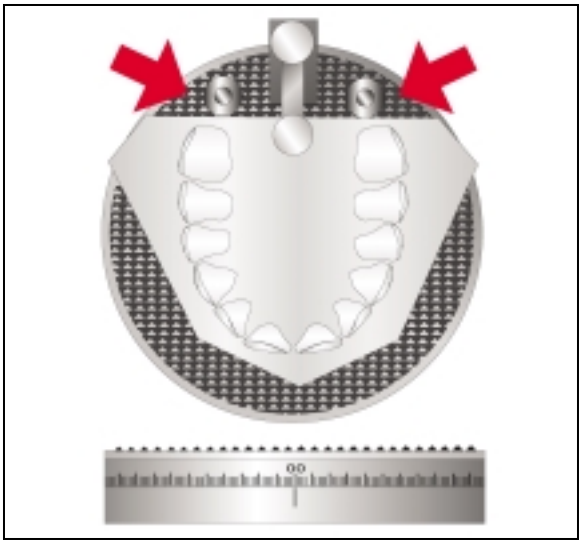

Fig. 7 Cast on rotating base in contact with posterior reference points.

Design and Use of the Ray Set System

The Ray Set is basically an upgrade of the Targ system, with a rotating base that provides precise control over the technique (Fig. 6). The cast-holder can be oriented in all three planes of space, thus allowing for individualized positioning of the brackets on each tooth. The Mitutoyo Micrometer Comparator*** allows vertical bracket positioning with a high degree of precision at the correct height according to the desired 2nd-order correction. A laser beam is used to help assess the correct torque.

The procedure for using the system is as follows:

1. Trim the cast as usual, then position it on the base, register it at the posterior reference points

***Mitutoyo Corporation, Kawasaki, Kanagawa, Japan.

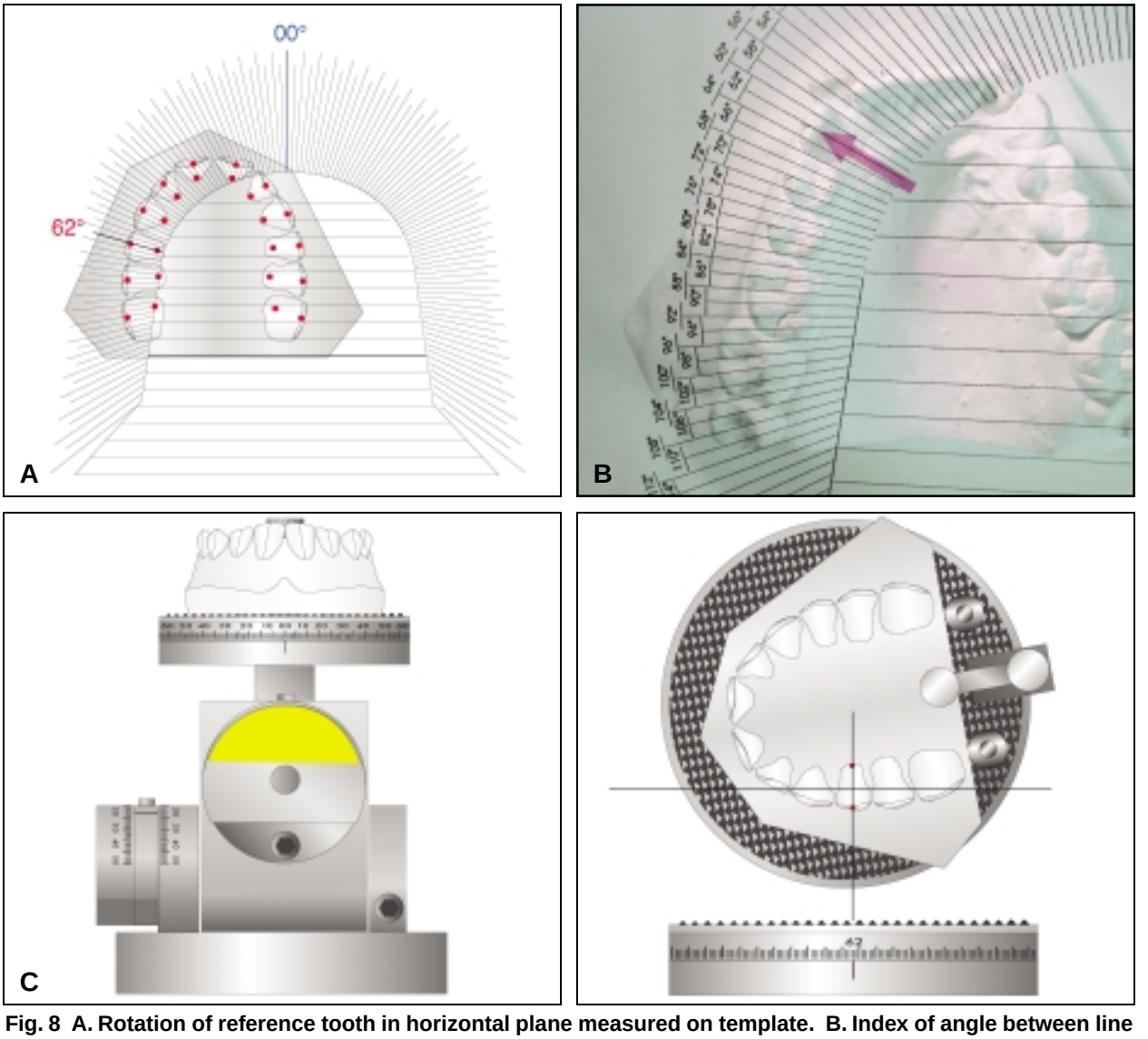

Fig. 8 A. Rotation of reference tooth in horizontal plane measured on template. B. Index of angle between line passing through crown and perpendicular line to posterior border of cast. C. Base rotated to angular index.

(Fig. 7), and fix it in place with the lingual stop.
2. Use the template to measure the 1st-order degree of rotation of the reference tooth (Fig. 8A). Take an index of the angle between the line passing through the crown and a perpendicular line to the posterior border of the cast (Fig. 8B). The rotating base allows orientation of the cast according to this angular index (Fig. 8C).
3. Orient the long axis of the tooth with the vertical rod of the mandrel, making sure that the vertical line is a tangent to Q point (the bracket bonding height). The goniometer is thus set to 0 tip (Fig. 9).
4. Determine the tip value required for 2nd-order correction by orienting the base, and thus the tooth, and measuring the prescribed tip angle

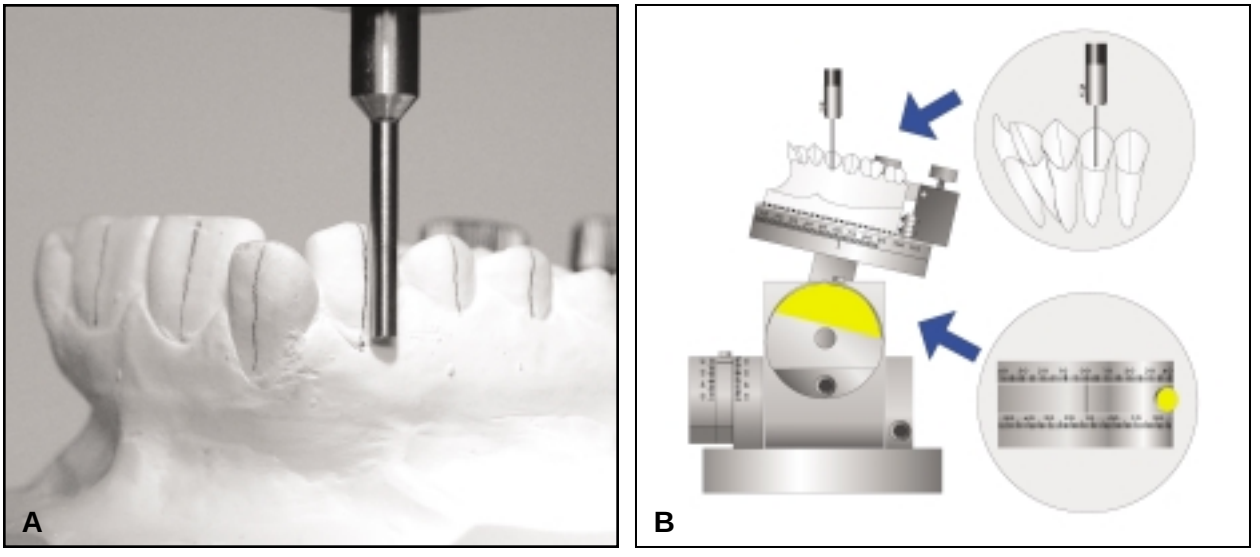

Fig. 9 A. Long axis of tooth oriented with vertical rod of mandrel. B. Yellow goniometer scale set to 0 tip.

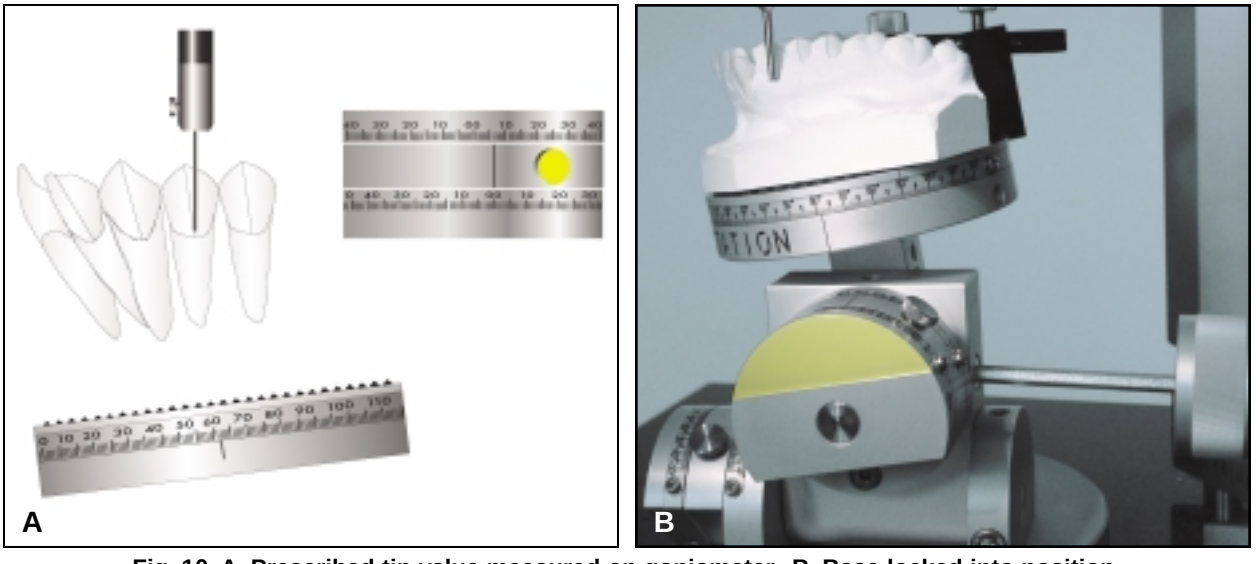

Fig. 10 A. Prescribed tip value measured on goniometer. B. Base locked into position.

with the goniometer (Fig. 10A). Lock the base into this position (Fig. 10B).

5. Place the bracket holder (without the bracket) at the appropriate vertical distance from the incisal edge of the tooth, using the precision vertical gauge. Mark the bracket height on the long axis of the tooth with a fine pencil (Fig. 11). This is Q point, which should be rechecked later following calculation of torque value.

6. Use the vertical rod and laser beam to determine the tooth position corresponding to 0 torque. Tilt the base in the 3rd-order plane until the vertical rod and the laser beam are tangent to Q point. The goniometer is thus set to 0 torque

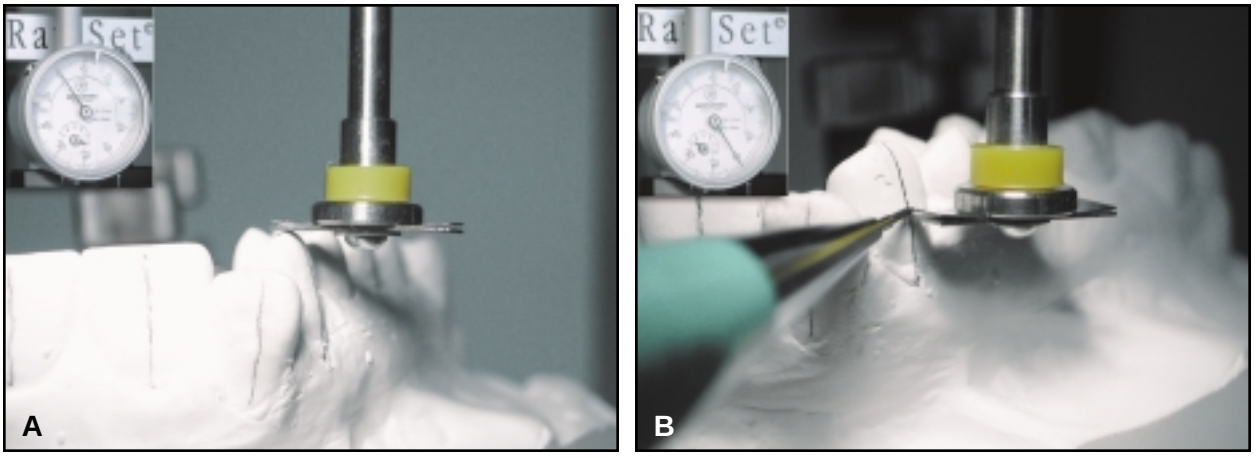

Fig. 11 A. Bracket holder positioned at incisal edge, with vertical gauge set to 0. B. Bracket height marked on long axis of tooth with fine pencil, with value indicated on vertical gauge.

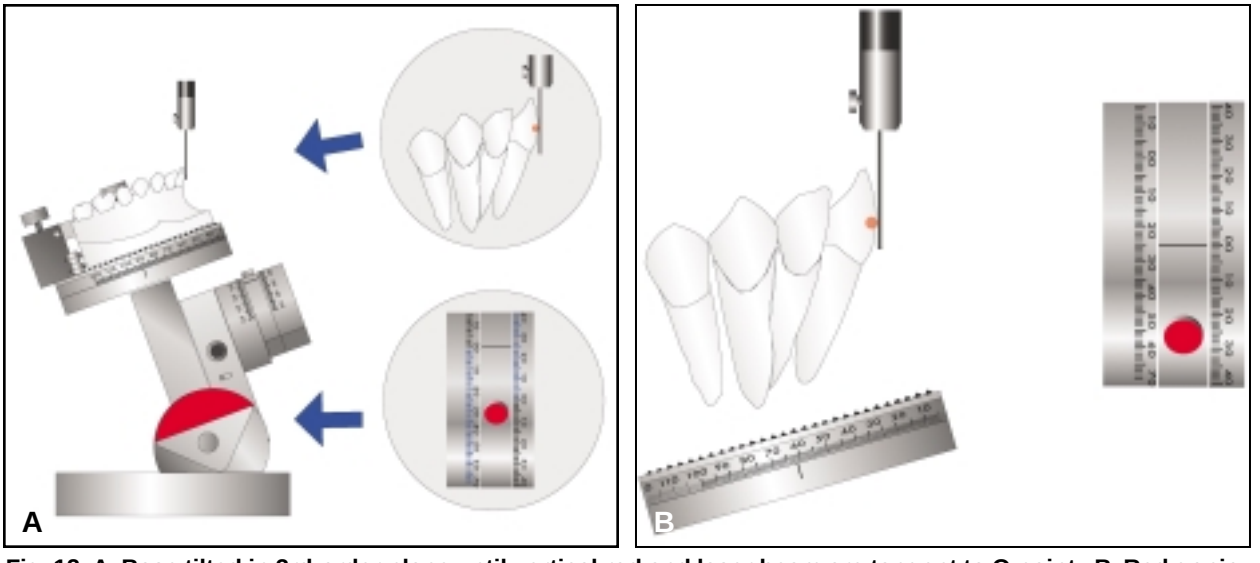

Fig. 12 A. Base tilted in 3rd-order plane until vertical rod and laser beam are tangent to Q point. B. Red goniometer scale set to 0 torque.

(Fig. 12).

7. Determine the torque value by orienting the base, and thus the tooth, and measuring the prescribed torque with the goniometer (Fig. 13A). Lock the base into this position (Fig. 13B).

8. The system compensates for discrepancies between bracket inclination and tooth surfaces by applying different amounts of light-cured composite, so that correct placement will result in the predetermined 1st-, 2nd-, and 3rd-order corrections (Fig. 14).

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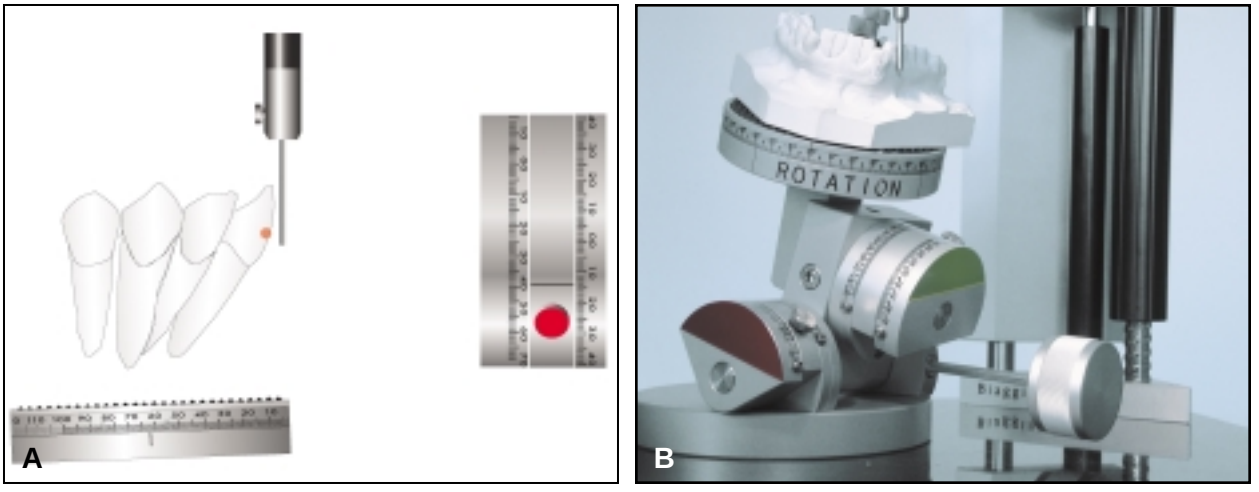

Fig. 13 A. Prescribed torque value measured on goniometer. B. Base locked into position.

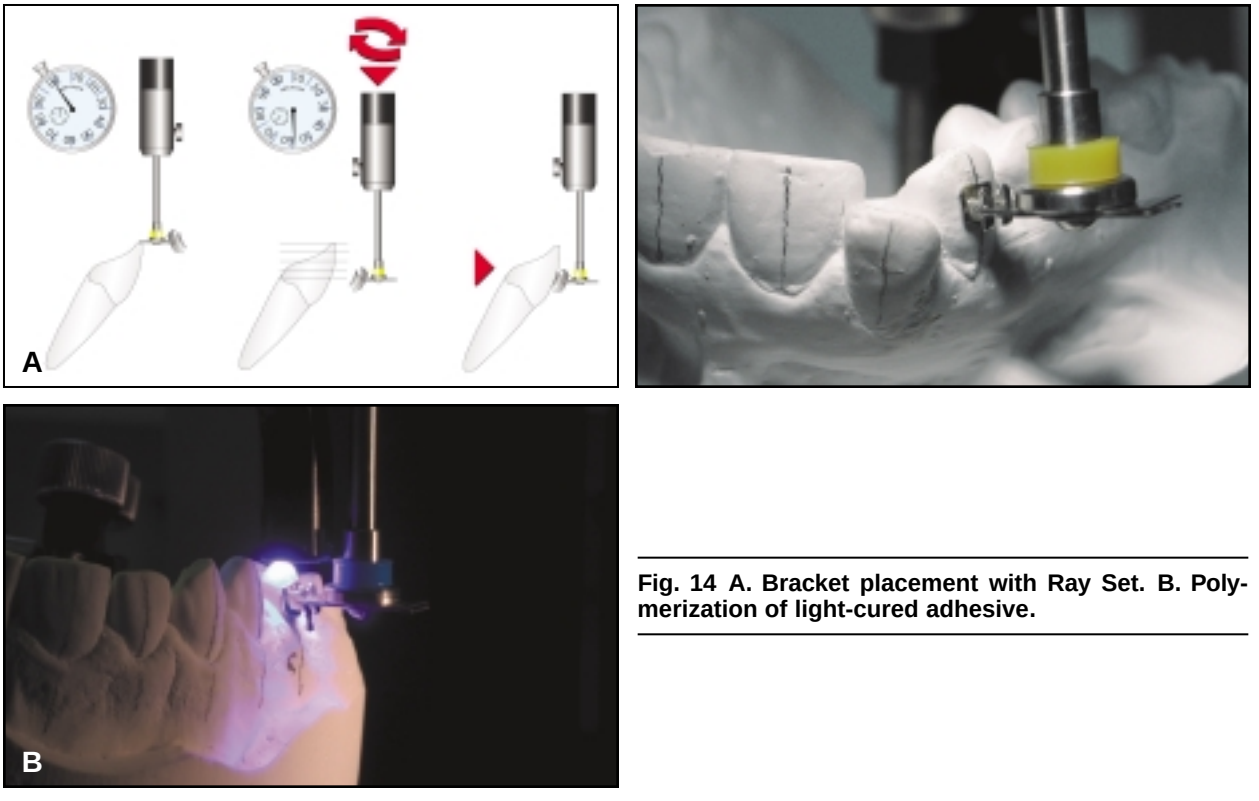

Fig. 14 A. Bracket placement with Ray Set. B. Polymerization of light-cured adhesive.

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