Debonding a New Ceramic Bracket: A Clinical Study

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Ceramic brackets provide an esthetic alternative to other bracket materials, with the advantages of stain and discoloration resistance, wear resistance (compared to plastic brackets), and functional strength. Metal or plastic brackets, on the other hand, are easier and safer to debond with a peel force, which fractures the adhesive at the bracket base. The rigid, brittle ceramic brackets cannot be peeled from the teeth.

Ceramic bracket manufacturers have addressed this problem in different ways. The recommended debonding procedure for a polycrystalline bracket with a vertical notch, such as Clarity,* is to compress the bracket mesiodistally so that it fractures along the vertical notch. Although this technique often results in a clean separation of the bracket from the adhesive, it can sometimes break off only the tie wings, leaving the bracket base still attached.

Other manufacturers have suggested applying a force at the tooth-bracket interface with a special metal debonding plier. The problem with this procedure is that it is difficult to engage the plier edges at the bracket-resin-tooth junction without contacting the bracket base. The bracket often fractures, which then requires the removal of remaining ceramic with a diamond bur.

The method recommended by the makers of a single-crystal aluminum oxide bracket, Inspire,** has been to attempt to remove the

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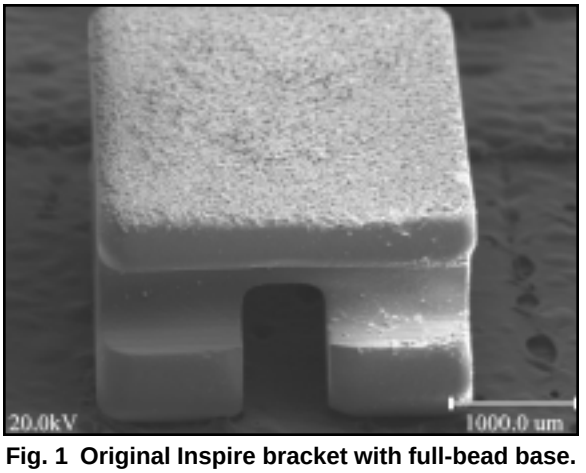
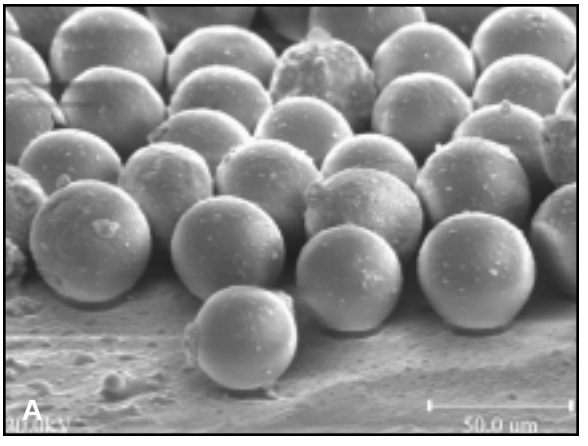


Fig. 1 Original Inspire bracket with full-bead base.



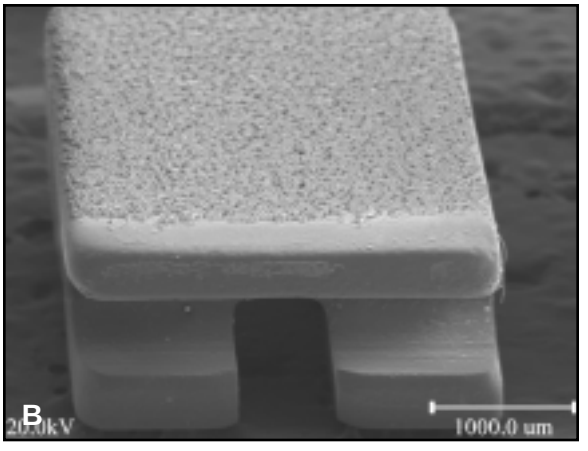


Fig. 2 A. Enlargement of retention beads. B. New Inspire Ice bracket base with 20% of gingival beads removed.

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entire bracket in one piece using a disposable plastic debonding plier. Although the plastic plier allows a torsional force to be applied without fracturing the bracket, the force required to remove the bracket may become excessive. Therefore, the manufacturer has recently reduced the area of retentive beads on the bracket base by 20% on the gingival side. A laboratory study and two clinical studies were conducted to determine whether this reduction in base retention makes bracket removal easier without jeopardizing bracket retention during treatment.

Preliminary Studies

Laboratory testing of the new brackets by the manufacturer indicated a significant reduction in the torsional debonding force required, with no corresponding reduction in the shear bond strength. A preliminary clinical comparison was then conducted. Equal numbers of the older, 100% bead bases (Fig. 1) and the test brackets with 20% of the gingival beads removed (Fig. 2) were bonded from maxillary canine to canine in 11 volunteer patients. The brackets were coded and then mixed before bonding so that the operator could not tell them apart. At the bonding appointment, the teeth were transilluminated, and any crazing lines were recorded.

After two weeks (a period deemed long enough to allow the bonds to reach maximum strength), the brackets were debonded. The relative force required to remove the brackets was rated from 0 to 3 (0 = no significant bond, bracket removed with ease; 1 = bracket removed by either plier pressure or plier pressure with a slight rotational force; 2 = bracket removed with a combination of plier pressure and moderate rotational force; 3 = excessive force required to remove the bracket). After bracket removal, the teeth were cleaned and transilluminated, and any new crazing lines were recorded.

None of the 66 brackets debonded prematurely during the two-week trial period. The force required to remove 44% of the older brackets and 65% of the test brackets was described as 1 (slight). The force needed to remove the remaining brackets was rated as 2 (moderate). There were no ratings of 0 or 3, and no new crazing lines were detected.

Fig. 3 Old and new Inspire brackets bonded randomly to maxillary anterior teeth.

Final Clinical Study

Based on the in vitro data and the preliminary clinical study, a large-scale in vivo study was conducted at Dr. Díaz's private practice in Mexicali, Mexico, using 100 volunteer patients. As in the initial study, equal numbers of the Inspire brackets and the test brackets (subsequently named Inspire Ice) were bonded to the maxillary anterior teeth, with the brackets randomly mixed before bonding (Fig. 3).

The same two operators bonded and debonded the brackets. Each tooth was etched for about 30 seconds with 37% phosphoric acid, then rinsed with an air-water spray for five seconds. The enamel surfaces were air-dried and coated with a resin sealant-primer (Ortho Solo**). All brackets were bonded with a light-

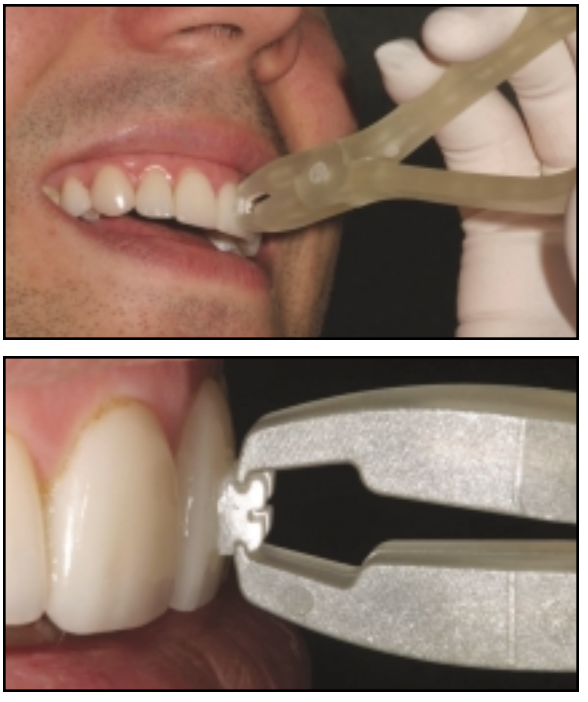

Fig. 4 Debonding procedure.

cured adhesive (Enlight***), using at least a five-second exposure with a Demetron** LED unit. Clear elastomeric ligatures were placed on the brackets, but no archwires were used. The 100 subjects were bonded over a two-day period (16 hours total), with an average bonding time of six minutes per patient.

There were no bracket fractures or bond failures during the two weeks before debonding. The brackets were removed and the teeth cleaned and polished over a 12-hour period, with an average time of four and a half minutes per patient. The debonding procedure was as follows:

1. The elastomeric ligatures were removed.
2. Each bracket was grasped with the plastic debonding plier, and the handles were compressed until they touched (Fig. 4). A new disposable plier was used for each patient.
3. The operator held the bracket momentarily with the plier before applying a slow rotational force toward the incisal.
4. After removal of the bracket, the remaining adhesive was reduced with a multifluted carbide bur and two sanding discs, followed by polishing with a rubber cup and fine abrasive.

The relative force required for bracket removal was rated from 0 to 3 as described above (Table 1). Three of the Inspire Ice brackets were rated as 0 (no significant bond). Two of the older brackets were rated as 3 (excessive force required) and were crushed and removed with a diamond bur. All other debondings occurred cohesively at the bracket base-adhesive interface. There were no bracket fractures or apparent enamel damage, and the patients reported no significant discomfort from the debonding.

Of the 294 Inspire Ice brackets that were bonded, 68.7% had a debonding rating of 1 (slight force). Of 295 original Inspire brackets, 55.9% received a rating of 2 (moderate force). The differences in mean ratings were statistically significant ($p < .001$). A t-test was also con-

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ducted to determine whether the mean ratings of the two brackets differed significantly from a rating of 1.5, approximating a hypothetical random distribution. The older brackets were significantly more likely to have a rating of 2, while the new brackets were more likely to have a rating of 1 ($p < .001$). In a tooth-by-tooth comparison, there were no significant differences between the two brackets except for the maxillary right lateral incisor—a result consistent with random expectations of multiple comparisons.

A logistical regression analysis indicated that the bonding operator was not an important factor in the ratings for either the old Inspire ($r = .17$, $X^2 = 1.02$, $p = .312$) or the Inspire Ice ($r = .18$, $X^2 = 1.61$, $p = .204$). The analysis did indicate a correlation between the debonding operator and the ratings for the old Inspire ($r = .45$, $X^2 = 5.80$, $p = .016$), but not for the newer Inspire Ice ($r = .01$, $X^2 = .966$, $p = .326$). Approximately 13% of the variance in the ratings was correlated with the subjects; in other words, variations within or between the patients could account for about 13% of the differences between the bracket ratings.

TABLE 1
DEBONDING FORCE RATINGS*

	0	1	2	3
Inspire bracket (full-bead base)				
Left canine	0	36	12	1
Left lateral incisor	0	29	21	0
Left central incisor	0	17	32	0
Right central incisor	0	4	44	1
Right lateral incisor	0	16	32	0
Right canine	0	26	24	0
TOTAL	0	128	165	2
Inspire Ice bracket (20% gingival beads removed)				
Left canine	1	36	12	0
Left lateral incisor	0	23	27	0
Left central incisor	0	27	21	0
Right central incisor	0	28	21	0
Right lateral incisor	1	42	5	0
Right canine	1	46	3	0
TOTAL	3	202	89	0

*0 = no significant bond, bracket removed with ease; 1 = bracket removed by either plier pressure or plier pressure with a slight rotational force; 2 = bracket removed with a combination of plier pressure and moderate rotational force; 3 = excessive force required to remove the bracket.

Conclusion

This clinical comparison of the older Inspire ceramic bracket and the new Inspire Ice indicates that the removal of 20% of the retentive beads from the base has significantly reduced the force needed to remove the bracket in one piece with a plastic debonding plier. Although the two-week time period of the study was considered long enough to obtain maximum bond strengths, it was not intended to test the longevity of the reduced-retention bracket bases. Results of the laboratory shear testing, however, combined with the high bond strengths of the earlier version of this bracket, lead us to believe that premature bond failures will not be a concern. ❑