

A comparison of retention rates of brackets with thermally-cured and light-cured custom bases in indirect bonding procedures

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This study compared the retention rates of thermally-cured (TC) and light-cured (LC) custom bases attached to metal mini-diamond brackets and clear Spirit MB brackets, when used in indirect bonding procedures. The custom base comprised either the light-cured or thermally-cured material attached to the bracket base and prepared in the laboratory, the whole unit later being bonded to the natural teeth. Thirty consecutively treated patients had fixed appliances fitted in both arches, with Spirit MB brackets on the maxillary anterior teeth, and metal brackets on the maxillary posterior and all mandibular teeth. All brackets were bonded using either the LC or TC method. All procedures and treatment was by the same operator, using identical techniques. Observation was for six months. All bonding failures were recorded. The results indicated no significant differences in the retention rates of either of the custom-base materials when used with metal brackets. However, the Spirit MB brackets exhibited a significantly higher bonding failure rate when a TC custom base was used. It was therefore concluded that either material could be used in the indirect bonding of metal brackets, and that LC custom bases should be used in the indirect bonding of Spirit MB brackets.

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Introduction

The attachment of orthodontic appliances was revolutionised by Buonocore,¹ who described the acid-etch technique in 1955, and Newman,² who applied this technique of attaching orthodontic appliances to the teeth for orthodontic treatment in 1965. These developments led to the modern age of bonded as opposed to banded appliances in Orthodontics.

Several devices and methods have been tried to make the task of attachment of orthodontic appliances easier and more precise. Indirect bonding was developed as one method to allow more precise bracket positioning. Most current indirect bonding techniques are based on the procedure developed by Cohen and Silverman.³ Their method of bonding brackets involves using a tray to hold the brackets, and positioning them by relating the tray to the occlusal surfaces of the teeth. Many improvements have been made to this technique, including better bracket design, better adhesive systems, and a number of useful additions to both the laboratory and clinical armamentarium. A further refinement is the use of custom bases, which can be made with chemically-cured, thermally-cured (TC) or light-cured (LC) composite resin. These improvements have resulted in an indirect bonding technique that compares very favourably with direct bonding techniques.⁴⁻⁶

The purpose of this study was to compare the effectiveness of the retention of TC and LC custom bases attached to clear Spirit MB* maxillary anterior brackets, metal mini-diamond Optimesh* maxillary premolar brackets, and mini-diamond Optimesh* mandibular brackets, when they are bonded indirectly.

Materials and methods

Thirty consecutively treated patients requiring fixed appliances in both arches were alternately designated to the TC- or LC- custom base groups (15 in each group). Spirit MB brackets were placed on the maxillary anteriors, and metal brackets on the maxillary posterior and all mandibular teeth. All patients were treated by the same operator.

Indirect bonding trays were fabricated on stone models from alginate impressions. In the laboratory, the brackets were positioned on the models with either Thermacure[†] or Transbond[‡] adhesives. The TC models were then placed in an oven at 150 degrees C for 15 minutes. The LC models had each metal bracket cured for 60 s with the light directed to both the occlusal (30 s) and gingival (30 s) aspects. The Spirit MB brackets were light cured for 20 s from the labial aspect. The indirect bonding transfer trays were vacuum-formed over the brackets on the stone models with 1.5 mm (0.06") clear mouthguard material. An outer tray of 1.5 mm clear splint material was also constructed to help stabilise the flexible inner trays during the bonding procedure. The bracket bases were micro-etched for 1 s to 2 s to remove any residue, and painted with acrylic monomer 10 min prior to the bonding procedure.

In the clinic, the buccal surfaces of the teeth to be bonded were etched for 30 s with 37 per cent phosphoric acid, rinsed with water for 10 s and dried with compressed air for a further 20 seconds. One arch was bonded at a time with chemically cured Maxicure,[†] as described by Geenty.⁶ Equal amounts of part A and part B were mixed and applied to the etched enamel and the bracket base. The bonding trays were then seated and held in place for 5 minutes. After the trays were removed, excess resin was removed with a hand scaler and initial archwires were ligated.

All patients were instructed to contact the office in the event of a bonding failure, and all dislodgements of brackets were recorded during the first six months of active treatment.

Results

One patient was lost from the study due to transfer and so the corresponding patient was dropped from the other group in order to maintain matched numbers (14 patients in each group).

The Spirit MB brackets exhibited 12 bonding failures in the TC group and none in the LC group (Table I). This was both clinically and statistically significant (heteroscedastic, one-tailed Student's *t*-test, ($p < 0.005$).

In contrast, the metal brackets in the TC group demonstrated no bonding failures in the maxillary arch and four in the mandibular arch. The bonding of the metal brackets in the LC group failed in two cases in the maxilla and in three cases in the mandible. These results were not significantly different in either the maxillary arch ($p = 0.17$) or the mandibular arch ($p = 0.38$).

Discussion

Indirect bonding can be a very predictable method of bonding when the correct combination of materials and techniques is used (custom bases can be fabricated with TC-, LC- and chemically-cured composite or glass-ionomer materials). In offices that use indirect bonding procedures, TC custom bases are popular as staff may place the brackets on the model at any time, leaving them until the orthodontist is available to position them prior to heat curing.

The results of this study are important as the high failure rate of the bonding of Spirit MB brackets with TC bases (~14 %) strongly supports the use of LC custom bases when bonding these particular brackets indirectly. The metal brackets exhibited a very high success rate (~2–3 % breakages) in both the TC and LC groups. For these brackets either method of custom base manufacture would appear to be satisfactory.

The higher bonding failure rates of the Spirit MB brackets with TC bases may be due to heat either affecting the integrity of the base of the bracket, or, because of the difference in thermal expansion between the bracket and base, causing distortion of the bracket or possibly creating micro-cracks in the custom base.

These results would indicate that similar investigations of the effect of heat on other types and brands of cosmetic brackets is required. However, until this data exists, the recommendation would be for non-metal brackets to light cure all custom bases to the model when the indirect bonding technique is being used.

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† Reliance Orthodontic Products Inc., PO Box 678, Itasca, IL 60143 USA.

‡ 3M/Unitek, 2724 S. Peck Road, Monrovia, CA 91016 USA.

Table I. Bracket failures in patients with thermally-cured and light-cured custom bases.

Spirit MB		Maxillary Metal		Mandibular Metal	
TC	LC	TC	LC	TC	LC
0	0	0	0	0	0
2	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	2	0
0	0	0	0	0	0
1	0	0	0	1	0
1	0	0	0	0	1
1	0	0	0	0	2
0	0	0	0	0	0
0	0	0	0	0	0
2	0	0	0	0	0
0	0	0	2	1	0
0	0	0	0	0	0
3	0	0	0	0	0
Total = 12	Total = 0	Total = 0	Total = 2	Total = 4	Total = 3
$p = 0.002$	$p = 0.17$	$p = 0.38$			

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