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Indirect bonding – do custom bases need a plastic conditioner? A randomised clinical trial

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Aim: To compare the clinical failure rates over six months of indirectly bonded brackets with and without methyl methacrylate monomer (MMM) conditioned custom bases.
Methods: Thirty-six consecutive patients satisfying the selection criteria were randomly assigned to two groups in a split-mouth study design. In Group 1, the maxillary right and mandibular left quadrants were indirectly bonded after the custom bases had been conditioned with MMM. The brackets bonded to the teeth in the contralateral quadrants were not conditioned. In Group 2, the custom bases on the brackets indirectly bonded to the teeth in the maxillary left and mandibular right quadrants were conditioned and the brackets in the contralateral quadrants were not conditioned. Over the 6-month observation period all loose brackets were recorded, and the data were compared with a Wilcoxon signed ranks test.
Results: Of the 828 brackets placed, six with the MMM conditioning came loose (1.4 per cent failed) compared with five in the Control group (1.2 per cent failed). The difference was not statistically significant ($p = 0.74$).
Conclusion: These results indicate that conditioning custom bases with methyl methacrylate monomer is an unnecessary step when indirectly bonding brackets.
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Introduction

The advent of the direct bonding of orthodontic attachments to the etched enamel surface in the mid-1960s by Newman[1] was a major advance in orthodontic treatment. In 1972 Silverman et al.[2] described a method of indirect bonding which involved placement of the brackets on a plaster model and then transfer of the attachments to the patient's mouth by means of a tray. In 1979, Thomas[3] refined this technique by bonding the brackets to the model with composite resin, thereby creating a custom base, which reduced the flash and facilitated the clean-up. Direct bonding of brackets is still the most popular method of attaching brackets to teeth, but indirect bonding is increasing in popularity. In 1990, 7.8 per cent of practitioners used indirect bonding, whereas by 2008 the number had increased to 13.2 per cent.[4]

Initially, bond failure rates for indirect bonding (13.9 per cent) were high compared with direct bonding (2.5 per cent).[5] However with modifications and improvements to the technique, the two methods now have similar bond strengths and failure rates.[6–8] As with any orthodontic procedure it is desirable for the technique to be effective and efficient. With indirect bonding, goals include minimising bond failures while also keeping laboratory and clinical procedures to a minimum. There are several recommended adhesives and bonding protocols, but limited clinical evidence to support their use. The validities of in-vitro studies of bond strength have been questioned which is exemplified by a clinical trial revealing that the failure rate of the adhesive was seven times that reported as being satisfactory in an in-vitro study.[9–12] For this reason prospective clinical trials are preferred.

Light-cured flowable adhesives and plasma and LED lights have reduced the handling times for indirect bonding. Clinical trials of indirect bonding have reported that light-cured adhesives have comparable bracket failure rates to chemically-cured adhesives.[13,14] In the clinical studies, the composite resin custom bases were lightly microetched in the laboratory and

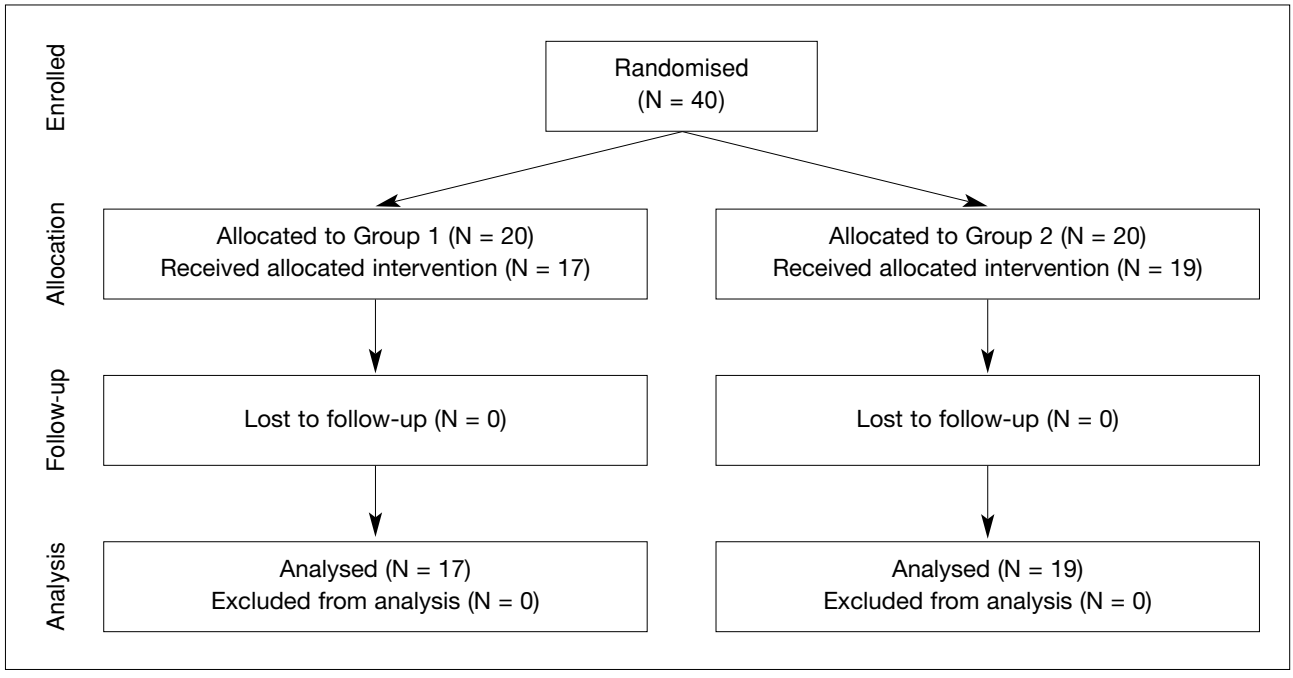

Figure 1. Study design.

then 10 minutes prior to bonding painted with methyl methacrylate monomer (MMM), which is believed to improve adhesion between the base and the bonding composite.[15] Other studies have used plastic conditioners, such as Enhance Adhesion Booster (Reliance Orthodontic Products, Ithaca, IL, USA) or the unfilled resin Orthosolo (Ormco, Glendora, CA, USA) to improve the bond strength.[16,17] The only laboratory study evaluating the conditioning of custom bases found that the highest bond strengths were achieved when the custom bases were microetched.[18] Conditioning microetched custom bases with Orthosolo resulted in lower bond strengths, particularly if too much resin was applied.[19] The evidence suggests that painting a custom base with some form of plastic conditioner is an unnecessary procedure and may even lead to a higher clinical failure rate. With these thoughts, it was decided to compare the clinical failure rates of indirectly bonded brackets with and without conditioned custom bases.

Materials and methods

Forty subjects were prospectively selected from the private orthodontic practice of the author for this randomised clinical trial. All subjects were informed of the purpose of the study and all agreed to participate. Subjects were randomly assigned to one of two groups in blocks of even numbers to ensure that each group had the same number of subjects. Subjects were excluded if one arch was to be treated, if all teeth (first molar to first molar) could not be bonded at the initial visit or if the number of teeth was asymmetric. After the enrolment period had ended, it was found that four subjects should have been excluded as all brackets could not be bonded at the initial visit so the total number of subjects was 36 (Figure 1). All subjects (17 in Group 1, 19 in Group 2) completed the trial. There were 21 females and 15 males and the mean age of the subjects was 14.2 ± 1.5 years. A total of 828 brackets was placed (Maxilla: N = 406; Mandible: N = 422).

The custom bases on the brackets bonded to the teeth in the maxillary right and mandibular left quadrants (from first molar to central incisor) were painted with MMM (Orthocryl, Dentaurum, Pforzheim, Germany) 10 minutes prior to bonding, whereas no conditioning agent was applied to the bases bonded to the teeth in the contralateral quadrants. In Group 2, the custom bases on the brackets indirectly bonded to the teeth in the maxillary left and mandibular right quadrants were conditioned and the brackets in the contralateral quadrants were not conditioned. In both groups the same prescription of precoated

Table I. Bracket failures over the 6-month observation period.

Total brackets (N = 828)	Failed	Failure (Per cent)	*p*
Total - Conditioned (N = 414)	6	1.4	
Total - Not conditioned (N = 414)	5	1.2	0.74
Maxilla - Conditioned (N = 203)	3	1.5	
Maxilla - Not conditioned (N = 203)	4	2.0	0.71
Mandible - Conditioned (N = 211)	3	1.4	
Mandible - Not conditioned (N = 211)	1	0.5	0.32

brackets (APC II adhesive, 3M Unitek, Monrovia, CA, USA) was used to form the custom bases and all custom bases were microetched in the laboratory.

After etching the enamel with conventional phosphoric acid etch for 20–30 seconds, the teeth were rinsed with water and thoroughly dried. A moisture insensitive primer MIP (3M Unitek, Monrovia, CA, USA) was applied to the teeth prior to bonding and all brackets were bonded indirectly using the flowable adhesive, Filtek Flow (3M ESPE, St Paul, MN, USA). The laboratory and clinical techniques have been described previously.[13,14] The only variations from this technique were that a flexible inner tray was used and the hard outer tray was omitted. The flexible tray containing the brackets was seated with light finger pressure and the tip of the curing light, to ensure intimate contact between the custom bases and the teeth prior to curing the bonding adhesive.

If the brackets interfered in the occlusion, a composite resin bite plane or wedge (Herculite XRV, Kerr Corporation, Orange, CA, USA) was built up on the palatal surfaces of the maxillary incisors or, if this was not suitable, on the buccal cusps of the lower molars, to prevent any contact with the lower brackets. A 0.014 inch thermally active NiTi wire (G & H, Greenwood, IN, USA) was the initial archwire. The normal wire sequence used after 10 weeks was a 0.016 x 0.022 inch thermally active NiTi wire (G & H, Greenwood, IN, USA) and after an additional 10 weeks a 0.016 x 0.022 inch stainless steel wire (G & H, Greenwood, IN, USA) was placed as the working wire. The number of loose brackets over six months was recorded for all subjects. Only the first occasion a bracket was dislodged was used in the analysis. The data were analysed using a Wilcoxon signed ranks test.

Results

Of the 828 brackets placed, a total of 11 brackets came loose during the study (Table I). Of these brackets, six had the MMM applied to the custom bases and five brackets were not conditioned. The failure rates for the brackets with conditioned and untreated bases were 1.4 per cent and 1.2 per cent, respectively (p = 0 .74).

In the maxillary arch, three brackets from the MMM quadrants were dislodged, compared with four brackets from quadrants with no monomer applied to the custom bases (p = 0.71). In the mandibular arch, three brackets from the MMM quadrants failed, compared with one bracket in the non-treated quadrants (p = 0.32).

Discussion

One of our primary goals as orthodontists is to provide quality, evidence-based treatment in an efficient manner for our patients. Based on the results of this study, the conditioning of custom bases with MMM is an unnecessary step: it did not result in fewer failed brackets. This result is supported by an in-vitro study which suggested that conditioning custom bases with Orthosolo was an unnecessary step when indirect bonding, but microetching the bases was extremely important.[18] The present clinical study and the in-vitro study referred to used brackets precoated with either APC or APC II adhesive from the same manufacturer (3M/Unitek, Monrovia, CA, USA). Adhesives from other manufacturers may have different compositions and bonding strengths so the results from the present study may not be applicable to these adhesives.

Other clinical findings relevant to the effectiveness and efficiency of indirect bonding have been published. Light-cured custom bases are reported to result in significantly higher bond strengths and lower bracket failure rates than heat-cured composite resin custom bases.[20,21] Another clinical trial found that microetching the enamel prior to conventional etching did not significantly affect the bracket failure rate when indirect bonding, indicating that this is an unnecessary procedure.[22] Clinical studies of adhesives have found the chemically-cured Maximum Cure (Reliance Orthodontic Products, Ithaca, IL, USA) and light-cured Filtek Flow (now available as Transbond Supreme LV; 3M Unitek, Monrovia, CA, USA) have lower clinical failure rates than the

chemically-cured Sondhi Rapid Set (3M Unitek, Monrovia, CA, USA).[12,14] Although the delay between the manufacture of the custom bases and the bonding of the brackets may vary from a few days to three weeks, delays up to 30 days have no effect on the bond strength.[23] Long delays between impression taking and placement of the brackets should be avoided as minor tooth movement could compromise the fit of the transfer trays and brackets to the teeth.

The bracket failure rates in this study (1.4 and 1.2 per cent) were at the low end of the range reported in previous studies of indirect bonding (1.4 to 13.9 per cent).[5–7,12,14,20] The use of composite bite wedges to prevent the teeth from contacting the brackets may explain the lower failure rates in the present study as not all previous studies used wedges to disclude the teeth.[6,5,12,14] To determine if the wedges contributed to the lower failure rate will require further investigation. The findings of the present study indicate that conditioning custom bases with MMM can be omitted without sacrificing bracket retention. Indirect bonding is an effective clinical technique with a low clinical failure rate over six months. The efficiency of the technique can be improved by eliminating unnecessary procedures, such as conditioning the custom bases.

Conclusions

Conditioning custom bases with methyl methacrylate monomer had no influence on the bracket failure rate.

The bracket failure rates in this study (less than 1.5 per cent) were low when compared with the literature, indicating that the method of indirect bonding employed in the present study is an effective clinical technique.

Occlusal wedges may contribute to bracket retention by protecting brackets from occlusal trauma.

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