Original Research

Clinical evaluation of bond failure rate of an indirect bonding technique

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Abstract

Aim: The aim of the study was to evaluate the bond failure rate of a cost effective indirect bonding technique.

Materials and methods: Modified Larry White's technique was used for this study. Twenty six patients were randomly allocated to two groups using the split mouth design where opposite quadrants were bonded using the direct and indirect bonding technique.

Results: Statistical Analysis of these groups revealed that there was no significant difference between the direct and indirect bonding techniques.

Conclusion: The indirect bonding technique produced clinically acceptable bond failure rates and hence can be easily incorporated into the orthodontic office.

Keywords: Indirect bonding technique, Hot Glue Gun, Bond failure rate

Introduction

The aim of modern orthodontics is to create the finest occlusal relationship within the framework of acceptable facial aesthetics and stability which requires positioning the crown of each individual tooth in its appropriate position for optimum function and appearance. With the advent of pre-adjusted appliance, great emphasis is being laid on accurate bracket positioning for the efficient application of biomechanics and for utilizing the full potential of this appliance. This may be aided by the indirect bonding technique.

Bjorn U. Zachrisson [1] defined indirect bonding as a 'technique in which the brackets are attached to the teeth on the patient's models, transferred to the mouth with some sort of tray into which the brackets become incorporated, and then bonded simultaneously.'

The development of transparent trays for indirect bonding made the use of light-cured adhesives possible. A major disadvantage of the transparent transfer trays was that it required vacuum forming equipments like the Biostar, Droformat, Drosoft etc. These equipments were expensive and the orthodontist needed to have a good laboratory support. Larry White[2] introduced a cost effective indirect bonding technique using a hot glue gun for making transparent transfer trays. The hot glue matrix offered a simple, reliable and inexpensive method for transferring brackets onto the teeth accurately.

The purpose of this study was to clinically evaluate the bond failure rates using a modified indirect bonding technique of Larry White.

The aims and objectives of this study were:

1) To evaluate and compare the differences in the bond failure rates between the direct and indirect bonding technique.
2) To evaluate and compare the differences in the site of failure for the indirect and direct bonding technique.

Materials and Methods

The present in-vivo study was performed on patients who reported to the Department of Orthodontics and Dentofacial

Orthopedics, SRM Dental College, SRM University, Chennai for orthodontic treatment.

Selection criteria

Patients were selected for the study on the basis of the following criteria:

1) Required orthodontic treatment of full upper and lower teeth with pre-adjusted edgewise appliances.
2) No presence of caries, large restorations, or hypoplasia.
3) Had no occlusal interference to eliminate its influence on bond failure rates.

An informed consent was obtained from all the patients who participated in the study.

Subjects were randomly allocated into one of two split mouth designs to reduce the possible effect of variability in cooperation, chewing habits, and access in individual subjects as well as to eliminate the influence of any operator bias (e.g. a right-handed operator may find it easier to bond the right hand side of the mouth) and isolation problems on the bond failure rate.

Twenty six patients (12 male and 14 female) were selected for the study. Their age group ranged from 13 to 28 years (mean 21.2 years) and the selected subjects presented with a variety of malocclusions. With the 'split mouth' design, each patient's mouth was divided into 4 quadrants. In 13 randomly selected patients (Group One) the maxillary right and mandibular left was cured using indirect bonding technique and the remaining quadrants were cured with direct bonding. In the remaining patients (Group Two) the quadrants were interchanged. Sample size was based on the number of teeth needed to demonstrate statistically significant differences between direct and indirect bond failures.

A total of 453 brackets were bonded. 7 brackets were not included in the study as they came off during tray removal or during extractions. Therefore 446 brackets were examined for the study of which 221 brackets were cured using indirect bonding technique and the remaining were cured with direct bonding.

Indirect bonding technique (laboratory stage)

Models were cast on the same day the impression was taken to ensure accurate fit of the transfer trays. Quadrants to be indirectly bonded were marked with vertical and horizontal reference lines for bracket positioning. The appropriate bracket was selected for each tooth and a small amount of Krafty Glue (Camlin's) ® was placed onto the base. Each bracket was then positioned on its tooth and the adhesive was allowed to set for 3-5 minutes.

Trays were made using hot glue gun. A molten matrix was formed over the entire lingual and occlusal surfaces and part of the facial surfaces of the teeth and brackets. The brackets were covered only partially, with care taken not to get the hot glue into the bracket slots as this would make the tray removal more difficult. Before the hot glue sets, which takes only a few seconds, the molten glue is patted into a close conformation, using a finger that is kept wet, insulated, and lubricated by means of a nearby bowl of water.

After the glue cools and hardens, the matrix and brackets were submerged in water for about 10 minutes to dissolve the Krafty Glue. The tray consisting of the matrix and brackets were then separated from the cast. Any remaining glue would be easily brushed away with a soft-bristle toothbrush and cold water. The excess glue is then trimmed off from the border of the matrix with a scissor (Fig 1).

Indirect bonding technique (clinical stage)

Following proper isolation the teeth were dried and etched for 20 seconds with etchant containing 37% phosphoric acid, in accordance with the manufacturer's instructions. Each tooth was then rinsed thoroughly for 15 seconds until all traces of the blue etching gel were removed before they were dried again with oil-free compressed air until they exhibited a frosty white appearance with no traces of moisture. Then a thin layer of Transbond™ XT primer was applied to the bracket bases and to the teeth in the quadrant to be indirectly bonded. A small amount of Transbond™ XT light cure orthodontic adhesive was placed onto the base of each bracket and the tray was seated with even pressure to allow good adaptation of the brackets to the teeth and an even thickness of composite resin. Molar bands were fitted in all four quadrants only after bracket placement, to ensure the accurate seating of the tray. Extractions were also carried out later for the same reason.

Care was taken to place a minimum amount of composite resin onto each bracket base to avoid excessive adhesive flash. Each bracket was cured using a standard light source for 20 seconds, 10 seconds on the mesial and 10 seconds on the distal aspect. Brackets were cured starting with the most posterior tooth, then moving forwards. The tray was then carefully removed using a scaler. Excessive adhesive flash was removed using rotary instruments if necessary (Fig 2).

Brackets were placed in the opposite quadrants using direct bonding technique.

To minimize variation in the magnitude of orthodontic forces applied to the teeth, a similar initial 0.016-inch nickel titanium arch wire was used in each case.

Record Collection

Working records were taken for each subject as they were treated consecutively. At each visit, a record was kept of the tooth type, date and circumstances of bracket bond failures. Only first time bond failures were recorded since it has been recommended that clinical studies evaluating bond failure rates should either only record first time failures or analyse multiple failures at the same site in a different category. All subjects were observed over a period of 1 year.

The differences in the bond failure rates between the direct and indirect bonding were examined using the Chi- Square test with Yates' Continuity Correction and Fisher Exact test. In addition to the simple event of failure, the event that elapsed before bond failure was studied using the Kaplan Meir estimates of survival curves and compared by using the Log Rank Test. The level of significance was defined as p value of 0.05 or less.

Fig 1: Transfer Tray

Fig 2: Indirect bonding Technique

Results

The results for this study are shown in the following tables and graphs. The incidence of bracket failures over the 12 months observation period for indirect bonding was 19 (failure rate of 8.6 per cent) and that for direct bonding was 16 (failure rate of 7.1 per cent) {Table 1}.There is no significant difference in the failure rates between the two techniques (P=0.60). The study also evaluated the bond failures for the anterior teeth in the indirect and direct bonding and found it to be 5.8 per cent and 6.4 per cent respectively and similarly, for the posteriors it was 14.9 per cent and 8.7 per cent. There was no significant difference in the proportion of failure rate between the two techniques (P=0.98, P=0.39) {Table 2 & 3}The mean survival rate between the two groups were plotted (Graph I & table IV).

Comparison of bonding failure rate between direct and indirect bonding

Table 1: Overall

Outcome	Direct Bonding [n=225]		Indirect Bonding [n=221]		P – value*
	No.	%	No.	%	
Failure	16	7.1	19	8.6	
Success	209	92.9	202	91.4	0.68(NS)

Table 2: Anteriors

Outcome	Direct Bonding [n=69]		Indirect Bonding [n=67]		P – value*
	No.	%	No.	%	
Failure	10	6.4	9	5.8	0.98(NS)
Success	146	93.6	145	94.2	

Table 3: Posteriors

Outcome	Direct Bonding [n=69]		Indirect Bonding [n=67]		P – value*
	No.	%	No.	%	
Failure	6	8.7	10	14.9	0.39(NS)
Success	63	91.3	57	85.1	

Table 4: Results of Kaplan Meir survival analysis

Group	Mean ± S.E. [95% CI]	P-value*
Direct Bonding	11.46 ±0.14 [11.19 to 11.74]	0.57 (NS)
Indirect Bonding	11.31 ±0.16 [10.99 to 11.62]	

SE Standard Error
CI Confidence Interval
*Log Rank Test was used to calculate the P-value

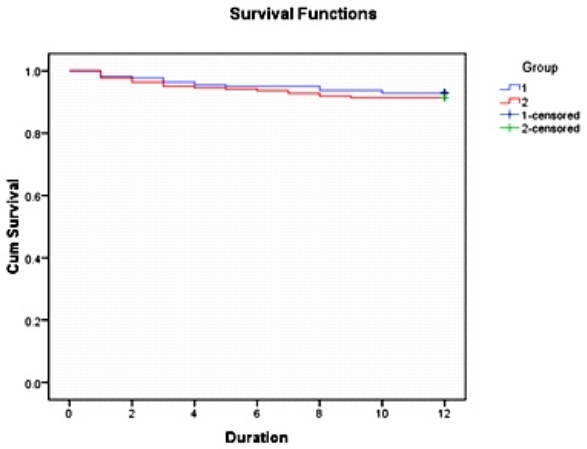
Discussion

The indirect bonding technique in this study uses a polymer of ethylene vinyl acetate which is FDA proven non toxic, non carcinogenic and available in the form of glue sticks[2]. The hot glue matrix which is used for fabricating the transfer tray is dimensionally stable and as it is clear therefore light cured composites can be used with this technique. As it is easily available and inexpensive it was desired to evaluate the bond failures with this technique.

The present clinical trial showed no significant differences in the number of bracket failures following indirect and direct bracket placements. The slight higher failure rate in the indirect bonding could be attributed to the fact that the transfer tray fabricated for one side of each mouth extended

only till the teeth to be bonded. The free edges of the tray may not have provided the adequate strength for the bracket adaptation to the teeth creating marginal voids within the adhesive resulting in an increase in the number of breakages. Previous in vivo studies suggest that bracket failure rates around 4 -12 % are to be expected [3,4,5,6]. Bond failure rates below 10% are generally considered to be clinically acceptable [7]. The results of this study are comparable with Aguirre et al [8], Thiyaharajah et al [9] and the recently conducted practice based study by Thomas Deahl et al [10]. They differ from the findings for Zachrisson et al (1978)[11] who reported significantly higher bond failure rate with indirect bonding technique but it is difficult to make direct comparisons with the study since the study used four different combinations of bonding techniques, adhesives and bracket bases for each patient.

Graph 1: Mean survival time in direct and indirect bonding groups



Group 1 = Direct bonding
Group 2 = Indirect bonding

The bond failure in between the anterior and posterior teeth were statistically insignificant which is in agreement with previous studies [12,13]. Among the different tooth there was no significant difference. The failure rate of brackets bonded to the posterior teeth (premolars) was found to be higher than the brackets bonded to the anterior teeth (incisors and canines) may be due to a number of factors, such as :

1) The partial eruption of second premolars [14,15];
2) The heavier occlusal forces exerted on the posterior teeth during mastication[16,17];
3) The larger amounts of aprismatic enamel on premolars affecting the quality of micromechanical bond [18,19].

Kaplan Mein survival plot for the two techniques demonstrated no significant difference in the mean survival time over the subsequent 12 months. (P=0.57) (Table 4).

Conclusion

This modified Larry White's technique which is a cost effective technique proved its value by producing clinically acceptable bond failure results and hence we can conclude that it is a reliable technique which can be used in orthodontics. Besides this it also offered the other added advantages of the indirect bonding technique. Further research is however needed to assess the accuracy of bracket placement of this indirect bonding technique and also its efficiency in terms of chair side time and laboratory time with the direct bonding technique as well as with other indirect bonding techniques. By establishing its merits this pocket friendly indirect bonding technique can then be easily incorporated into the orthodontic office.

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