

Indirect Bonding Procedures in Orthodontics - A Review

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Abstract

Indirect bonding (IDB) has been in orthodontic practice for more than 35 years. But still, most of the clinicians use direct bonding procedures. The main reason for this may be technique sensitivity and requirement of extra laboratory procedures, increasing the cost of the treatment. Many researchers have tried their methods to describe the indirect bonding procedures so that it can reduce the chair side time required for complete appliance placement with more precise bracket positioning. Moreover, the IDB procedures provide more patient comfort. Many techniques have been described in the article to simplify the IDB procedures.

Keywords

Bonding; Indirect bonding; Transfer tray

Introduction

The initially fixed appliances used the technique of attaching the brackets and tubes to the bands on the individual tooth. But there were very much limitations in the accurate placement of these bands during cementation on each tooth. Then direct bonding in orthodontic practice enabled the clinicians to position the brackets and tubes more accurately than when using bands. Direct bonding was initially achieved with chemically cured resin set with the disadvantage of the shorter working time. This problem was solved by the advent of light-cured composites which provided the sufficient time to the clinician to place the brackets and tubes more accurately. The precise bracket placement in posterior teeth with direct bonding still remains questionable and furthermore increased chair side time requirement was again an issue

Various Indirect Bonding Techniques

Indirect bonding (IDB) was introduced in 1972 by Silverman et al. [1] using an unfilled methyl-methacrylate based adhesive (BisGMA) in order to place brackets on to a model in the laboratory prior to being attached to the patient's mouth. Silverman and Cohen [2] in 1975, improved this technique by using a perforated mesh base and ultraviolet (UV) cured BisGMA resin.

Sugar Daddy technique was proposed by Swartz [3] in 1974 using caramel candy as an adherent to place brackets to models. After the final trays have been completed, the caramel candy-water soluble material was removed from the back of bracket base and mesh pads were exposed for bonding in the clinic. The clean base method with a single silicone delivery tray is the original technique used in indirect bonding.

Moin and Dogon [4] developed a technique in which a drop of sticky wax was placed on teeth surfaces of the cast. Brackets were warmed over a flame and set on the cast. Impressions made with polyether material and tray separated from the cast but brackets remained in situ. Brackets removed from a cast, warmed again to remove residual wax and placed into the impression. Enamel surface applied with a mixture of universal and catalyst sealant, bracket base covered with the adhesive and tray seated. There was sufficient time for corrections until optimal bracket alignment was obtained.

Thomas [5] developed a technique which became the foundation for contemporary indirect bonding. In this technique, the brackets with composite resin on their bases were bonded directly to the working casts. The D-P (Vanguard) vacuum former hooked to the vacuum mixer was used as a vacuum source. This apparatus was used to vacuum form the placement tray made from the heated arch blank. After good adaptation has been achieved, cold water was poured onto the top of the vacuum former to hasten the cooling of the tray material. The teeth were painted with liquid "sealant" Universal resin (Part A) and liquid "sealant" catalyst resin (Part B) was painted to the composite bases. Trays were removed after chemical cure polymerization. The entire process resulted in a minimal flash and relatively easy clean-up.

Read and O'Brien [6] and Read and Pearson [7] used the transfer trays made from a transparent material which allowed the use of light cured adhesive resins rather than the self-cured adhesive resins.

Article Information

DOI: 10.31021/jddm.20181120
Article Type: Review Article
Journal Type: Open Access
Volume: 1 Issue: 4
Manuscript ID: JDDM-1-120
Publisher: Boffin Access Limited

Received Date: 10 July 2018
Accepted Date: 19 September 2018
Published Date: 20 September 2018

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Citation: Aggarwal P, Aggarwal R. Indirect Bonding Procedures in Orthodontics - A Review. J Dents Dent Med. 2018 Aug;1(4):120

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Reichheld et al. [8] used bracket placement jigs, in place of a transfer tray. He used brackets with preformed height gauges and reinforced each height gauge with a small amount of sticky wax. Placed a small piece of soft rope wax over the cusp tips. Embedded the occlusal rests of the height gauges in the wax until they contact the incisal surfaces of the teeth and the bracket bases contact the labial surfaces of the teeth. Since the wax remains soft, there was no time limit on positioning the brackets. All brackets placed in the same manner and rope wax was removed. Then he made a cold-cure acrylic splint that transferred the brackets from the model to the mouth. After curing, the splint was removed from the model with gentle force. Transfer the acrylic splint to the mouth using your preferred indirect bonding system. This technique generally takes only 15 to 20 minutes [8].

Hickman, 1993 introduced a 'dual-tray' transfer system with chemically-cured composite. Cooper and Sorenson, 1993; Kalange, 1999; Sondhi, 1999 developed the adhesive pre-coated brackets (APC) having the ease of placement and reduction of chair time [9-12]. Sinha et al. [13] used the thermally-cured, fluoride-releasing indirect bonding system in which the mixed sealants contained hydrogen fluoride.

Moskowitz et al. [14] used thermal-cured adhesive system and Reprosil vinyl polysiloxane impression material as a modification to Thomas technique. The casts were placed in a heated oven to cure at a temperature of 325°F for 15 minutes. The thermal-cured adhesive allowed a virtually unlimited working time for placing brackets on the stone cast. The impression material formed a flexible but highly accurate under tray that can easily be removed. Then a vacuum form Essix .020" or .030" clear thermoplastic material was used over the cast, brackets and under tray complex [14].

A new approach to the indirect bonding technique using light-cure composites was done by Kasrovi et al. [15] in 1997. In spite of using non-transparent trays as in conventional indirect bonding, he modified the fabrication of transfer tray and provided direct visualization and access to the brackets –during both lab and clinical procedures. The technique was highly predictable and reproducible. Visibility and accessibility from start to finish made the Orthodontist to clean off excess composite around the brackets and apply light cure when fully satisfied with bracket position and hygiene.

Sondhi [12] presented efficient and effective indirect bonding using APC brackets. Using APC brackets, contamination was eliminated and laboratory time was cut to a minimum because individual brackets did not need to be having resin applied to the base before placing on a model. The viscosity of the resin was increased with the use of a fine particle fumed silica filler (approximately 5%), so that any small imperfections in the custom base crafted from the light-cured adhesive can be taken up by the filled resin. Transfer trays were fabricated by using Biostar unit to vacu-form a 1 mm thick layer of Bioplast, overlaid with a 1 mm thick layer of Biocryl. Alternatively, a silicon putty could be used as a transfer material. Trans bond moisture insensitive primer (MIP) applied to enamel surfaces. He used resin A onto the tooth surface and resin B painted on the resin pads in the indirect bonding tray.

White [16] used Tacky Glue to place brackets on the cast which was inexpensive, water-soluble adhesive. The glue was removed during the tray transfer stage. He also used a hot-glue gun to form the matrix of the transfer tray for use with an indirect technique using chemically cured composite. Silverman and Cohen [17] tried bonding with a Plasma-Arc Curing Light and Resin-Modified Glass Ionomer bonding adhesive. A new generation of high-intensity curing lights now makes it possible to complete a full bonding much more quickly and efficiently.

Sachdeva [18] designed a Sure Smile Technology, in which in vivo dental arches were scanned using Ora Scanner, three-dimensional visualization tools formed a digital diagnostic setup for bracket positions on the target arch. The result provided an electronic prescription of the arch wire design and customized bracket positions on the image of the original malocclusion. Accordingly, arch wires and precision vacuum form bracket trays were fabricated which

can be used to indirectly bond the brackets using Reliance Maxicure Sealants A & B [19].

Raffaeli et al. [20] developed a new process based on different tools embracing Reverse Engineering, CAD data elaboration, and Rapid Prototyping technologies. The CA Dental software with 3D shape acquisition systems used to scan impressions and plaster casts and with the rapid prototyping machines used to build physical models and trays. Bonding trays were manufactured in white medical ABS polymer with the creation of thickness over teeth leaving holes for brackets. These holes were having particular shapes to hold the brackets and in the meanwhile let them out without difficulties. According to the adhesive used, photo polymerizing light can be used and when the adhesive has dried out it was possible to remove the trays.

Higgins [21] presented indirect bonding with a custom base made from light-cured adhesive cured in Triad 2000TM visible light-curing unit. He laid down beads of Affinity TMCrystal Clear transparent vinyl polysiloxane to capture brackets. Transfer tray fabricated using 0.5 mm clear Splint Biocryl over the VPS. The tray was less bulky. Filtek adhesive was applied on a custom base and Ortho Solo painted to etched enamel surface during bonding procedure.

Vashi and Vashi [22] advocated the use of thermoplastic glue as earlier tried by White in 1999. But the trays were not sufficiently rigid during full arch indirect bonding. So, thermoplastic impression compound was used along with thermoplastic glue to increase the rigidity of transfer trays. The technique being an economical and quick method for indirect bondings.

Bhardwaj et al. [23] used double sided sticky tape to place brackets on working cast and used vacuum formed thermoplastic soft transfer tray. Madhusudhan et al. [24] used micropore adhesive tape with cyanoacrylate glue to affix the brackets to the cast and gelatin jigs prepared over brackets for additional retention. Transfer tray fabricated using 2mm thick Bioplast.

Besides these, many researchers have tried their methods to accomplish indirect bonding by changing their ways during laboratory or clinical procedures.

Most of the techniques described have

1. Clean base with auto cure paste
2. Custom base with auto cure sealant
3. Custom base with auto cure paste
4. Custom base with light cure sealant

Advantages and Disadvantages are shown in Table 1 and Table 2 respectively

S.No	Advantages
1.	Better visualization in placing brackets on model
2.	Improved ability to bond posterior teeth
3.	Optimizing the use of doctor's time
4.	Reducing staff chair side time
5.	Improves patient comfort
6.	Adds value to the practice
7.	Less likely need for repositioning of brackets
8.	Potentially reduces treatment time

Table 1: Advantages of IDB

S.No	Disadvantages
1.	Technique sensitive
2.	Additional set of impressions needed
3.	Increased lab time
4.	Increased lab expenses
5.	Cost of additional materials

Table 2: Disadvantages of IDB

Special considerations in lingual orthodontics

The difficulty in access and vision when working on the lingual surface and the huge variation in morphology of the lingual/palatal surface of the teeth can mean direct bonding extremely difficult. Indirect bonding is preferred as it can significantly reduce the chairside time and facilitates a superior final end result. The various indirect bonding techniques for lingual bracket setup are-

CLASS system- Customized Lingual Appliance Setup Service

HIRO system- A CLASS set-up but using archwires and individual tooth transfer trays

KIS system - Korean Indirect Bonding Set-up System

TARG system - Torque Angulation Reference Guide

DALI system - Dessin de l'archlinguale informatise

BEST system - Bonding Equal Specific Thickness

TAD system - Torque Angulation Device

TOP/INCOGNITO 1 BRACES system - Transfer Optimized Positioning

LBJ- Lingual Bracket Jig method

Simplified technique

Hybrid core system

Slot machine

Orapix System

Among these, Orapix System is the newest technique in which a scanner will scan a patient's model and create a three dimensional (3D) data file. The orthodontist will receive the 3D data file of the patient and a 3-Txer software package via the Internet. With the 3-Txer software, the orthodontist will visualize a 3D model and will be able to create his own virtual set-up on his computer for that particular patient. The information is sent back to the laboratory via the internet [25].

Lab and clinical procedures for custom base with light cure sealant using PVS material tray

(Figure 1 to Figure 28)



Figure 1: Stone model with desired markings



Figure 2: Applying separating medium



Figure 3: Adhesive for making custom pad



Figure 4: Brackets placed as per prescription



Figure 5: Curing light cure adhesive



Figure 6: Poly vinyl siloxane material used

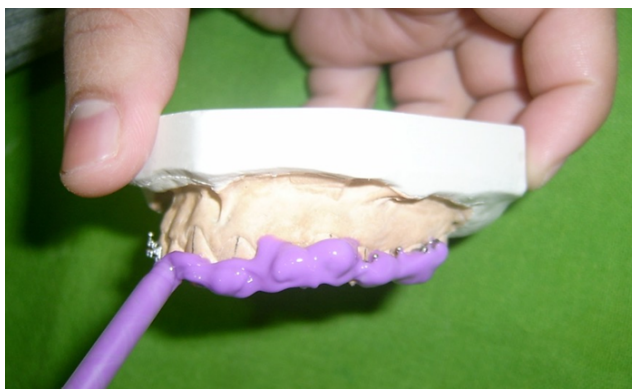


Figure 7: Light body PVS application



Figure 11: Putty placed on model



Figure 8: Equal volume PVS putty base and catalyst



Figure 12: Putty shaped to final



Figure 9: Hand mix PVS putty material



Figure 13: Model immersed in water



Figure 10: After mixing putty shape like cylinder



Figure 14: Tray removed from model



Figure 15: Tray sectioned



Figure 19: Moisture insensitive primer and two bottle system resins



Figure 16: Sand blast with aluminium oxide particles



Figure 20: Applying resin B on bracket base custom pads



Figure 17: Store in box



Figure 21: Applying resin A on enamel surfaces



Figure 18: Clean with prophyl cup and pumice



Figure 22: Seating the anterior sectioned tray to dentition



Figure 23: Removal of tray



Figure 27: Brackets bonded to right posterior teeth



Figure 24: Seating the posterior sectioned tray to dentition



Figure 28: Arch wire inserted to brackets



Figure 25: Brackets bonded to anterior teeth

Procedure for fabrication of custom base with light cure sealant using vacuum formed tray

(Figure 29 to Figure 35)



Figure 29: Placing brackets on stone model with markings and light cured



Figure 26: Brackets bonded to left posterior teeth



Figure 30: Tray cut to desired perimeter



Figure 31: Marking the tray boundary



Figure 35: Storing in box

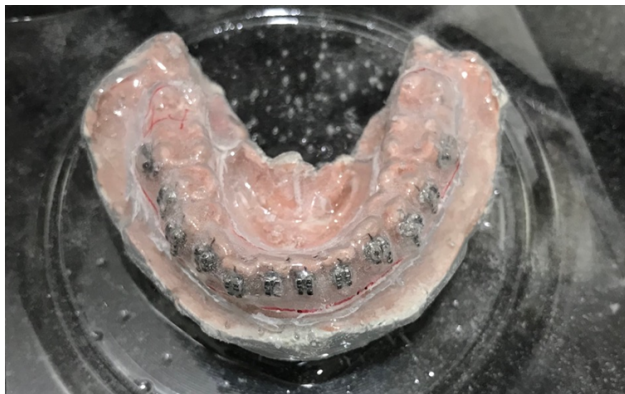


Figure 32: Tray cut to desired perimeter



Figure 33: Tray sectioned

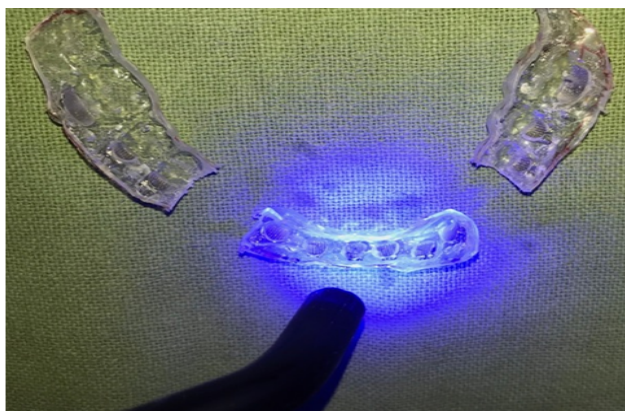


Figure 34: Light curing custom pads completely

Indirect Bonding Steps (for custom base)

Laboratory procedures

1. Prepare a die stone model (colored stone) from an accurate alginate impression. After trimming the model, bubbles if any should also be trimmed off with great care so that tooth anatomy should not be altered. Voids should be filled up with stone. Let the stone model dry completely before going to the next step.

2. Mark the horizontal and vertical reference lines as per bracket prescription. Apply 2 thin coats of 50-50 mix of separating medium to the working model. The 2 thin coats of separating medium must dry thoroughly before brackets are placed in the next step.

3. Place the brackets onto the working model using suitable adhesive as per the indirect bonding technique used. Colored die stone model will help for bracket adhesive contrast during bracket placement. Remove excess flash around the brackets and cure according to the technique used (chemical cure, light cure or thermal cure). If a light cure composite is used to form the custom pad, it must be completely cured with extra time because the access to light between the model and the bracket base is limited, otherwise risk of microscopic layer of composite being left on the model which would cause a cleft between the custom pad and the enamel intraorally and a compromised bonding. This is not as much of a concern with ceramic brackets.

4. Make the transfer tray over the brackets on the stone model using poly-vinyl siloxane (PVS) or vacuum formed sheets or combination as per the technique used. Trim away excess bulk from the tray, if vacuum formed/ suck down method used.

5. Immerse the working cast with a tray in water for 1 hour to soak it well and let the separating medium dissolve. Gently remove the tray from the model with light pressure and cure the custom bases again to ensure that if any uncured resin has been cured.

6. Clean the transfer tray with a dishwashing detergent in an ultrasonic cleaner and wash thoroughly. A tooth brush can be used to clean the tray. With compressed air, blow dry the tray to remove any water. Trim the tray to the desired final size and dimension.

7. The tray can be sectioned at this stage if required. If there are significant crowding and imbrication of the teeth, it gets easier to handle if section the tray. Give a short sandblast to the adhesive custom bases with a fine aluminum oxide particle (50 µm). The tray can be stored in a box for the next clinical visit of the patient.

Clinical procedures

1. Clean the teeth with prophyl cup pumice. Etch the enamel surfaces for 30 seconds by applying only to the surfaces that are to be covered by the brackets and also avoiding etch to contact skin or gingiva. Do not allow the etch to flow into interproximal areas. The cleanup will go much more smoothly if this is kept in mind. Rinse, dry and isolate thoroughly using the dry angles, cheek retractor.

2. Resins/ sealants should be used as per the indirect bonding technique used. Moisture insensitive primers are available and

optional if visible moisture on the enamel surface can be controlled. If required a coat of moisture insensitive primer should be painted on the enamel surface and air dry for 2 seconds.

3. If a two bottle system is used, then apply universal resin on enamel surfaces and apply catalyst resin on bracket bases. Seat the transfer tray to the dentition and make sure it is seated accurately and hold it in position with slight finger pressure so that brackets and teeth surfaces are in full contact.

4. Curing procedure should be followed as per technique (chemical cure or light cure).

5. Remove the transfer tray with great caution to peel the tray from the lingual to buccal. Use extreme care when removing the tray from around bracket wings. The scaler can be used for removal.

6. Excess resin around the brackets should be cleaned off and contact surfaces should be free from any resin. Dental floss can be used to check that all contacts are open.

7. Repeat the steps similarly if sectioned the tray. Brackets are ready for archwire insertion.

Unusual bonding challenges i.e. ceramic restorations, large metal restorations, hypocalcific teeth are still bonded indirectly utilizing the specific techniques recommended by the adhesive suppliers.

Indirect Bonding Prescriptions

If the models are required to send lab then a proper indirect bonding prescription should include the doctor name, corresponding address, patient name, date shipped, date required. Regarding case information give details about labial or lingual, upper, lower arch or both, slot size 0.018" or 0.022", brackets enclosed or provide brackets- metal or ceramic, brand name of brackets, a diagrammatic prescription indicating standard or custom heights, over rotations, missing teeth, teeth need to be extracted or not to be bonded. Regarding transfer tray design select full arch, midline split or 3 sections. Any special instruction should be mentioned and signed by a doctor along with his/her registered license number. Any enclosure like a copy of panoramic radiograph can be sent along with prescription if desired.

Conclusion

The majority of fixed appliances bonding is carried out using direct bonding procedures. Over the years, advances such as customized precise bracket placement, specialized adhesive system, and transparent transfer trays have helped indirect bonding become a highly accurate and dependable system that doctors now can rely on with the highest of confidence. Amongst the various indirect bonding techniques available, this is the personal choice of the orthodontist to choose the indirect bonding technique while performing the procedure. Moreover, the indirect bonding promised similar bond strength and easier debonding because less resin was left on the teeth [26]. So, considering the patient comfort along with the clinician ability to show more expertise results indirect bonding is preferred.

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