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INDIRECT BONDING: A REVIEW OF LITERATURE

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Abstract:

Abstract- The ease & convenience of indirect bonding results in reduced operator's chair side timings, increased patient comfort & High precision in bracket placement. The various chemicals used to bond the brackets are discussed in this article. A fair advantage of indirect Bonding over direct bonding is accurate appliance placement, thus reducing chances of marginal ridge discrepancies & lateral open bite.

Key words – Working model, Indirect Bonding, Water soluble adhesive, Light Cured Material, Transfer Trays, Adhesive Coated Brackets

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Introduction

A well known fact that many orthodontists will believe; that the brackets can be positioned more accurately on the study models than directly on teeth in the mouth. Gorelick[32] in 1979 reported that fewer than 17% of orthodontists routinely used an indirect bonding technique. Reasons commonly given for not using the indirect method are the expense of the materials, the additional laboratory procedure, the necessity of training laboratory personnel, and the difficulty in achieving consistent and predictable adhesion to the teeth.

Indirect bonding, is a technique in which orthodontic brackets or other attachments are transferred from working models and bonded onto the dentition using a transfer device. Indirect bonding was first described in detail as a concept in 1972 by Silverman and Cohen.[1] Some of the initial trials used a softened Sugar Daddy® candy (Tootsie Roll, Inc., Chicago, IL) as a means of attaching the brackets to the working models before transfer tray fabrication.[2,3] Additionally, others have used water-soluble adhesives[4] and even sticky wax[5] to attach the brackets to the models. Eventually this concept evolved to include application of various adhesive-coated brackets as a means of creating custom bases to aid in the bonding process.[6,7]

Cohen and Silverman suggested the possibility of a completely indirect bonded practice as early as 1974, and the idea of an emphasis on indirect bonding continued in certain circles throughout the 1970s.[8] This concept was even extended to the possibility of attaching face bows to bonded buccal tubes. Silverman and Cohen further stated, "It should take no longer than twenty minutes to complete a full strap-up in the mouth in both arches, including second molars if desired."[9] Modern techniques have expanded on this concept and have utilized precision bracket placement techniques[10] and "high tech" composites as a means of

facilitating indirect bracket placement.[11,12]

As early as 1974, Newman talked on the use of acrylic-based adhesives to direct and indirect bond plastic and mesh base brackets.[13] Thomas discussed a modification of the Silverman and Cohen technique in which Concise or Dyna-bond were used to form a custom base.[14] This technique was the first to describe the construction of these custom composite bases, and utilized a two-part liquid sealant to bond the brackets to the dentition with the aid of a clear vacuum-formed transfer tray.

Fried and Newman discussed the use of a no-mix adhesive in indirect bonding in the literature in 1983.[15] As early as 1984, the concept of a rapidly setting curing system took place when Aguirre experimented with varying setting times by changing Concise catalyst/base compositions.[16]

In going through the articles published about indirect bonding, it becomes apparent that the topics fall into various categories. In terms of the types of chemicals used to bond the brackets, this concept can be divided into three distinct categories: thermally cured bases, themal cured and light cured. In addition to these, separate categories can be used to discuss articles related to bond failure rates, accuracy of direct versus indirect, certain management and cost effectiveness discussions, and specific techniques for bracket placement measurements. Also, there are certain developing technology based applications, and miscellaneous articles that do not fit into any of the above mentioned categories. With reference to methods for bracket attachment for indirect bonding, chemically cured composites were the choice for some of the initial trials.

In chemically cured methods bis-GMA adhesives are generally used. However, other chemicals like resin-reinforced glass ionomers,[17] acrylated epoxy adhesives,[13] and cyanoacrylates.[18-20] have been tested and included now.

Silverman and Cohen in 1972[21] gave their original technique on the use of light cured materials and by 1974 gave an elaborated study on it. So, by that time light cure materials became an adjunct to the chemically cured ones. The pit and fissure sealent was used then in the two step plan before the light cure. Thomas[28] in 1978 said that most indirect bonding can be traced to a previously developed process. A liquid catalyst resinis applied during chairside bonding onto a composite layer that can be procured in the laboratory. A thin layer of sealer is onded additionally onto the enamel.

Read and O'Brien, in 1990 used a visible light cured adhesive in indirect bonding on foil mesh based brackets.[22] Whereas Silverman and Cohen used ultraviolet light-sensitive benzoin methyl ether component for activation. Hamula[23] in 1991 supported these concepts of indirect bonding and he talked on a lot of advantages of it over the direct bonding. Few enlisted advantages by him included : less chair side time, no chance of bracket drifting, unlimited time for bracket placements, more of accuracy. During that time Adhesive precoated brackets was introduced. Cooper was the first one who described these; the use of these precoated brackets in indirect bonding technique.[24] A year later, Cooper and Sorenson used a modified technique to place APC metal and ceramic brackets in indirect bonding.[7]

In 1998, Read and Pearson Read and Pearson, were the first to discuss the use of a light cured, lightly filled sealant to attach brackets with a custom resin base to the teeth via an indirect method.[25] In 2001, White used a self-etching primer and a quick cure composite adhesive in indirect bonding.[26] This light cured bonding technique involves considerable time and expenditure. Silverman and Cohen in 2002 introduced lamps with high light intensities inducing short polymerisation time. Miller in 2005 introduced the 'all in one adhesive' i.e. etching, primimg and bonding in one step.[27]

Indirect bonding involves many systems designed to precisely place brackets. Therefore, a discussion regarding the need for a controlled method of bracket positioning logically succeeds the discussion of the transfer tray. To begin this discussion, we can refer to an interview between Gottlieb and Phillips in 1980.[38] As a leading proponent of indirect bonding during this time frame, Phillips described the use of vertical long axis lines on the working models. He stated, "You may want to change position of the bracket on the model. That is the reason I believe the indirect method makes for more precision: because, if it's hard to do in the laboratory, it's definitely harder to do in the mouth, where you have much poorer access and can't draw lines like you can on a model."[38]

There have been relatively few studies done that compare direct bonding versus indirect bonding in relationship to accuracy. Gianelly stated, "One of most common and universal problems that I have seen is incorrect appliance placement, with consequences such as the creation of

lateral openbites, and marginal ridge discrepancies. The main advantage of an indirect bonding technique is that it reduces errors."[40]

One might think that the concept of a clear transfer tray would logically follow the development of light-cured composites. However, Thomas, in his original thesis, discussed the use of a vacuum-formed clear "placement tray" as early as 1979.[14] There has been resurgence in the use of various forms of clear transfer trays, as light-cured composites became available for use in indirect bonding.[7,29] Sinha[39] in 1995 introduced transfer trays to allow light cured composite adhesive to be used for coating the bracket base.

Sondhi[30] introduced the sondhi method in 2007. In this technique, the team developed a resin designed for indirect bonding. After various laboratory tests and clinical trials, an effective indirect bonding procedure has been developed. They used two resins; one for the tooth surface and another for the bracket base. For the transfer tray, inside(bioplast) one was softer than the outside (biocryl) one.

Vashi[31] in 2008 modified the transfer trays. They used a combination of thermoplastic glue and impression compound to prepare transfer trays. The impression compound is thermoplastic material used in prosthodontics. Glue consists of ethylene vinyl acetate copolymer, which is non toxic, non cariogenic and FDA approved. To prepare transfer tray, impression compound is warmed with a flame torch and placed onto the occlusal and lingual surfaces of the teeth of the working models. After that, the brackets are placed onto the working models. After that, the brackets are placed onto the working models. Then, the brackets are placed onto the working models. Then, the glue is flowed from the glue gun which adheres to the impression compound and covers the brackets on all sides.

In 2001, Littlewood[33] suggested a minimal adhesion value of 5.4 MPa, where brackets can be lost in five percent of the cases. Zachrisson and Brobakken in1978[34] determined a higher bracket loss with indirect bonding. Aguirre et al in 1982[35] reported a lower rate loss. Sinha in 1955[36] reported a loss of five percent, which corresponds to a percentage rate of 1-5, and Gia[37] in 2003 found no significant differences between in SBS between direct and indirect bonding.

There are several difficulties associated with doing accuracy studies in comparing direct versus indirect bonding. The primary problem is in establishing an adequate definition of where the brackets should be placed to define "ideal." A definition for ideal bracket placement is obviously necessary for comparative purposes. Accuracy studies need heterogeneity to establish validity and should therefore encompass a broad range of malocclusions including extraction, nonextraction, adults, adolescents, and so forth. Unfortunately, existing studies have failed to satisfy these requirements.

Equally controversial are studies related to the bond strength comparisons between direct and indirect bonding techniques. There are claims of bond strengths adequate to withstand the rigors of treatment in cases that are indirect bonded from second molar to second molar. These claims may be attributed to better conformation of bracket bases to the teeth, reduction in chair time, and the reduced risk of saliva contamination.[41] Bond failure studies have been performed both in vitro and in vivo.

There are many proposed advantages associated with indirect bonding,[42,43] and it has even been proposed as the mandatory mode of placement, especially in lingual cases.[44] Many advocates believe that reduced chair time and delegation of the procedure make it cost-effective.[45] In fact, Hodge and coworkers investigated the cost effectiveness in a hospital dental clinic and found a significant cost savings when using indirect bonding versus direct bonding in that setting.[46] In addition to cost effectiveness, there are numerous additional benefits reported.[14,47] These benefits include enhanced patient comfort, elimination of the need for separators and bands, easier ability to rebond brackets, easier ability to build in over corrections, better in/out and better vertical control, and improved oral hygiene because of generally smaller attachments. Benefits also include optimal use of staff, reduced inventory and associated costs, fewer appliance placement and removal appointments, and overall healthier ergonomics.

Nowadays, technology is very fast driven. It has become part of everything. High technology computer driven systems are developed for orthodontists, especially for indirect bonding. With any new development, there is always a fear of unknown.

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