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Review Article

Differences of direct and indirect resin composite and its effect on esthetic restoration

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ABSTRACT

As a result of the increasing needs among the public to enhance esthetics, many approaches have been made and the results included different approaches as non-metallic tooth-colored restorations, including the direct and indirect resin composites. In addition, another approach is the ceramic onlays or inlays. In this study, we aim to formulate strong evidence regarding the differences between direct and indirect resin composite the clinical outcomes, and related effects on esthetic restorations, based on evidence obtained from the current and previous studies in the literature. Many differences were discussed within the study manuscript between the direct and indirect resin groups. Furthermore, evidence shows that esthetic outcomes are in favor of the latter. We also discussed the color stability outcomes for the two groups and evidence in this area was controversial. Finally, many studies have reported that the clinical efficacy of the indirect resin composites is superior to the direct ones, while many others reported that they are similar, and only a few reported that direct resin composites are superior. Accordingly, further studies are encouraged to unify these contradicting results.

Keywords: Restoration, Composites, Resin, Direct, Indirect, Estehtics

INTRODUCTION

As a result of the increasing needs among the public to enhance esthetics, many approaches have been made and the results included different approaches as non-metallic tooth-colored restorations, including the direct and indirect resin composites. In addition, another approach is the ceramic onlays or inlays.[1] There are growing demands and practices for resin composites use for restorations in recent years as a result of the many demerits that have been

associated with ceramic restorations as high cost, brittleness, increased risk of fractures, and wear induction.[2] In this study, we aim to formulate strong evidence regarding the differences between direct and indirect resin composite the clinical outcomes, and related effects on esthetic restorations based on evidence obtained from the current and previous studies in the literature. Many differences between direct and indirect resin composites were reported in the literature according to both clinical and laboratory investigations and will be discussed in this section. Among the reported features, studies have demonstrated that polymerization shrinkage is more with the direct resin composites as compared to the indirect ones because the latter requires the application of extra curing with heat, light, and pressure that are usually before outside the oral cavity.

DISCUSSION

It has been observed that the restorations resulting from indirect resin composites are relatively smaller in size than the direct ones as a result of the extra-oral preparation and polymerization shrinkage. However, the lost space has been reported to be usually compensated by the presence of luting cement in these restorations Figure 1.

Figure 1: An example of cementation of an indirect resin composite restoration.[32]

Another difference between the two modalities is the need for secondary polymerization. Although direct resin composites are usually well-cured, it has been estimated that the degree of conversion only occurs to up to 65%, which might not undergo complete polymerization, which has been a big limitation to these modalities. On the other hand, indirect resin composites are reported with higher degrees of polymerization because as previously mentioned, they usually undergo further polymerization preparations by light, heat, pressure, and light curing. Accordingly, it has been estimated that the modalities are usually stronger and harder, with an estimated higher degree of conversion in up to 81% of them, probably due to increased amounts of polymerized resin particles.3,4 Besides, it was previously reported that the indirect resin composites have a higher resistance to occlusal wear than the direct ones, with an estimated value of <1.5 µm/year, which is probably due to the significantly enhanced physical properties of the modality. Another advantage of the indirect resin composites is the enhanced occlusal morphological outcomes as a result of the good control over the contours and other related structures because indirect composites are usually fabricated outside the oral cavity. Filler contents are also more abundant in the indirect composites than the direct ones, which significantly enhances the physical properties of the compounds leading to enhanced strength, hardness, wear, and marginal integrity, and accordingly, the prognosis with these modalities is usually better than with the direct ones.

Regarding esthetics, many previous studies have also reported on this outcome. Because indirect resin composites can be polished and fabricated within a laboratory, they have been reported with enhanced esthetics and better retention outcomes that usually lasts for an extended period over the outcomes that can be associated with the direct composites.[3,4] The attending clinicians can successfully obtain the pink and white desirable esthetics results because indirect resin composites can provide a variety of color combinations to the tooth and adjacent gingival tissues. In this context, a previous investigation by Lee et al compared the direct and indirect resin composites in their abilities to maintain color resistance following thermocycling.[5] The authors reported that although no significant differences were noticed between the two modalities in terms of color stability after 5,000 cycles of thermocycling. A significant difference was noticed regarding the changes in color coordinates. Besides, they also reported that the brand, shade designation, and shade group were all noticed to have a significant influence over the color changes of the indirect composites. The color changes with the two types of resin composites are attributable to many causes as chemical degradation, accumulation of stains, oxidated carbon double bonds, water resorption, dehydration, intact with rough surfaces, poor bonding, and water sorption.[6-12] These causes can be either endogenous or exogenous and all have been reported to induce significant color changes to the resin composites.[6,7,11] Furthermore, internal color changes have been reported to be even more important clinically than others regarding the color stability of the restoration materials. These have been reported to be in a significant association with the form and type of the applied material and the period taken to perform polymerization.[9,12] On the other hand, a previous investigation by Dietschi et al reported several factors that can significantly enhance the color stability of the different types of resin composites, including increased filler to resin ration, water resorption, decreased particle hardness and size, and maintaining optimized matrix-filler coupling systems.[6] Previous investigations of the color stability estimated with the indirect resin composites show that these types of composites are associated with sufficiently significant stability outcomes following storage in red wine and ultraviolet radiation.[13] On the other hand, other investigations also reported that for 300 and 383h of

accelerated aging, indirect resin composites were associated with unacceptable outcomes of color stability and esthetics.[14,15] The aging of the indirect resin composites in ultraviolet radiations, coffee, mouthrinse, and tea was significantly associated with reduced color stability and unfavorable discoloration outcomes, as reported in a previous investigation by Stober et al.[16] Accordingly, these variables should be considered with patients caring for esthetics to obtain better outcomes.

It should be noted that the cost of indirect resin composites is higher than the direct ones, which is attributable to the extra laboratory work to achieve temporization and impression. Additionally, increased reduction of the tooth structure is also another disadvantage that is usually observed with the indirect composites, a process that is done to develop adequate removal and insertion paths. Besides, it should be noted that changing the modality or modifying the colors is difficult as these are usually manufactured within the laboratory after many procedures. It was also demonstrated that the luting thin layer at the resin cement is subjected to shrinkage during the luting procedure for completion of the restoration process. Many indications and contraindications were reported for the indirect resin composites. Indirect composites are indicated for laminate veneers, inlays and onlays, jacket crowns, full-coverage crowns, restorations based on implant support, in cases where occlusal coverage is required as in patients suffering from periodontal conditions or bone loss, retainers or bridges inforced with fibers, and in cases of indirect anterior restorations in patients suffering from enamel hypoplasia, fluorosis, abrasions, previous non-satisfactory esthetic restoration-related experiences, and diastemas.[3,4,17] On the other hand, indirect resin composites should not be considered for the restoration of teeth suffering from a severe tear or wear as a result of temporomandibular joint affection and occlusal disharmony, in cases of parafunctional harmful habits, and in cases where isolation of the area where the procedure should be performed is difficult because indirect resins are sensitive. Despite the advantages of the indirect resin composites and the reported characteristics, reports from clinical studies indicate that both the direct and indirect modalities have almost similar favorable outcomes regarding esthetics and patient satisfaction.[18,19]

Many studies of different designs have compared the direct and indirect resin composites, and evaluated their clinical outcomes. A previous investigation by Karaarslans et al has included 70 patients with 140 included teeth, of which 70 were included in the direct resin group while the other 70 were included in the indirect composite group.[20] The latter included Gradia Posterior (GP), Surefil Posterior (SP), P60 (Filtek P60 [FP]), and the Tescera ATL (TATL) system TESCERA™ ATL™ (Aqua, Thermal, Light) while the indirect resin composite group included SP, GP, FP, and the Bisco Aelite LS Packable (BAP). The authors evaluated many variables including marginal discoloration, surface texture, color matching, marginal integrity, retention, the adaptation of the gingival tissues, development of secondary caries, and the development of postoperative symptoms. They reported that the indirect resin composites were significantly associated with reduced postoperative sensitivity, the roughness of surfaces, and irritation of soft tissues. In addition, the clinical outcomes were more favorable with this group than the other one. These results were furtherly indicated by another investigation by Ozakar-Ilday et al that included 49 participants with 60 teeth and were divided into 20 and 40 teeth within the direct and indirect resin groups, respectively.[21] Manhart et al also reported that better anatomical outcomes were significantly more associated with the indirect than the direct resin composite group, in their cohort of 45 patients with 60 included teeth.[22] In the same context, another comparative investigation by Scheibenbogen-Fuchsbrunner et al also concluded that the indirect resin composites had significantly more superior anatomical outcomes than the direct composite group.[23] Another investigation by Scheibenbogen et al finally confirmed this by showing that the group that received indirect resin composite restorations had better outcomes regarding the occlusion and anatomical forms than the other group that received direct inlays.[24]

Another investigation by Fennis et al evaluated retention outcomes in 157 patients with 176 premolar teeth.[25] The included premolars were divided into two groups, including the indirect composite (n=82) and the direct composite group (n=92). They showed that the difference between the direct and indirect resin composites that were performed in their investigation was statistically non-significant. These results are consistent with the findings by Cetin et al that evaluated many variables as marginal discoloration, surface texture, retention, color match, associated postoperative symptoms, marginal integrity, the development of secondary caries, gingival adaptation.[26] The authors included 54 patients with 108 teeth that were divided into 67 and 41 teeth within the direct and indirect resin composite groups, respectively. The included direct composites were Tetric EvoCeram (TEC), Filtek Supreme XT (FSXT), and AELITE Aesthetic (AA), while the included indirect composites were E and TATL. The authors reported that no significant differences were estimated between the two groups in terms of the aforementioned variables. The findings are that the outcomes with the direct and indirect resin composite groups are not significantly different. They were also reported in a previous investigation by Cetin and Unlu.[27] Pallesen and Qvist also evaluated the long-term outcomes for both modalities, and the findings also revieled that the differences are not statistically significant.[28] Furthermore, Wassell et al also reported similar findings as no significant differences were noticed between the direct and indirect resin groups that were administered with the same materials for all the included study participants.[18] Moreover, it should be noted that the authors reported that no advantage of the direct composite modality was noticed over the conventional one. Finally, Wassell et al concluded that no significant differences were noticed between the

two groups that included composites made from the same materials.[29] On the other hand, another investigation by Mendonça et al reported that the direct resin composites were superior to the indirect ones in terms of marginal integrity.[30] Another investigation by Bartlett and Sundaram concluded that neither direct or indirect resin composite restorations should be used for the management of severely worn posterior teeth.[31]

CONCLUSION

Evidence shows that esthetic outcomes are in favor indirect resin gtoups. Furthermore, color stability outcomes for the two groups and evidence in this area was controversial. Finally, many studies have reported that the clinical efficacy of the indirect resin composites is superior to the direct ones, while many others reported that they are similar, and only a few reported that resin composites are superior. However, preservation of tooth structure is better in direct resin. Regarding cost effectiveness, it is notable that direct resin is superior than indirect resin. Further studies are encouraged to determine the controvorseries between them.

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