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Sandwich Technique in Primary Teeth: A Review

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Abstract

Background and Aim: The sandwich technique is a restorative method where the lost dentin is replaced with glass ionomer (GI) cement and the lost enamel is replaced with composite resin. Various modifications of this technique have been introduced in order to increase the longevity of this restoration. Hence, the aim of this review article was to assess the use of sandwich technique in primary teeth.

Materials and Methods: After an initial screening of potentially relevant articles through electronic search of journals indexed in PubMed Central, Science Direct, Wiley Online Library, Springer and Google Scholar, articles on sandwich restorations in primary teeth were included.

Results: Literature suggests that the sandwich technique is successfully practiced in carious lesions in permanent teeth; however, very few studies are done on primary teeth.

Conclusion: With the advent of newer resin cements and bonding agents, the sandwich technique is much simplified. However not enough clinical studies are available in the literature on the sandwich technique and its modifications in primary teeth. More studies need to be conducted in primary teeth using this restorative technique.

Key Words: Composite Resins; Glass Ionomer; Deciduous Tooth

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Introduction

The sandwich technique was first introduced by Wilson and McLean in late 1970's and 1980's wherein glass ionomer (GI) cement was used to replace the lost dentin followed by the placement of composite restoration to replace the lost enamel [1]. The concept of sandwich restoration was based on the principle of biomimesis defined by Bugliarello as "the attempt to imitate features of living systems". It means that it would be better to replace the lost natural tooth structure with materials that best replicate the biological essence of the lost tissues [2].

Composite resins have long been used in restorative procedures wherein they are directly bonded to the enamel. The enamel is etched and conditioned followed by infiltration and polymerization of a resin material. This type of restoration can be retained in the oral cavity for a long time. After placement of a composite restoration, there are various external factors that come into play such as the masticatory forces, occlusal stress, and thermal and hydrodynamic effects that lead to microleakage and ingress of bacteria along with internal factors such as enzymatic degradation of collagen matrix and resin leaching [3,4]. This results in postoperative sensitivity. Hence, placement of a GI base under the composite is considered a smarter option. It provides advantages of establishing a reliable gap-free chemical bond to dentin and a micromechanical bond to composite resin. It protects the pulp tissue from irritation, has a fluoride releasing property which has a cariostatic effect, and helps in reducing the bulk of composite resin which leads to less polymerization shrinkage [5].

According to Croll and Cavanaugh [6], the only disadvantage of sandwich restoration is that it is a time consuming technique. However, the advantages of this type of restoration outweigh its disadvantage. With recent advances in GI cements and bonding agents, complexity of sandwich restoration technique can be simplified. Extensive search of literature did not reveal any comprehensive reviews on this topic. The following review of literature shows different techniques and modifications of sandwich restoration carried out mainly in primary teeth.

Review of Literature

Sandwich restorations were further categorized into 2 types by Wilson and McLean in 1977[1]. These were open and closed sandwich techniques. The closed sandwich technique involves placement of GI cement at the base of the proximal box not extending to the cavo-surface margin. After setting of GI, the cavity is etched with phosphoric acid followed by application of dentin bonding agent. Composite material is then placed as final restoration. GI is enclosed within the preparation and not exposed to the outer surface. The open sandwich technique involves application of GI restoration at the base of a proximal cavity up to the level of dentinoenamel junction. Composite resin is then placed over it leaving a portion of GI exposed to the oral cavity. The main benefit of the open sandwich technique is that exposed GI helps in buffering changes that occur in presence of an acidic pH and hence it is a commonly used technique [7]. Reid et al. [8] assessed the microleakage and gap size at GI and composite resin interface in sandwich restorations in primary teeth. Microleakage scores were found to be the highest for the closed sandwich group when the cavosurface margin was placed on either dentin or cementum. The lowest microleakage scores were obtained for the open sandwich group when the cavosurface margin was placed on the enamel.

However, clinical failures were seen with the use of open sandwich technique mainly because of continuous loss of GI material from the cervical margins of proximal restorations. This was due to two main factors namely (I) moisture sensitivity of GI at the time of placement and (II) crazing and cracking seen due to early set and dehydration. Hence, newer resin modified glass ionomer (RMGI) cements came into play.

RMGI has shown to have a higher bond strength as compared to the conventional GI [9,10]. The resin component in RMGI supplements the chemical bond that GI achieves with the tooth structure through micromechanical bonding. This double bonded mechanism helps in longer retention and achieving a good marginal seal in this restoration. According to Pereira et al, [11] better sealing produced by RMGI is the result of resin tag formation into the dentinal tubules along with ion exchange process that occurs at dentin/RMGI interface. An additional reason is the presence of 2-hydroxyethyl methacrylate (HEMA) in RMGI. A major advantage of using RMGI is that the material is polymerized upon light activation. Carvalho et al. [12] and Davidson [13] suggest that RMGI could help in changing the configuration factor of a material to obtain a more favorable internal structure, minimizing the polymerization shrinkage. Some authors believe that relative flexibility of RMGI helps in reducing stress produced in the restoration. Stiffness of composite after curing is also reduced, preventing bond failure [14]. Many other materials such as flowable composite, flowable compomer, and various bonding agents were evaluated as a lining agent under composite resin.

Hagge et al. [15] evaluated the marginal sealing ability of four different base materials (RMGI, flowable composite, flowable composite with a bonding agent, and flowable compomer) applied before placement of a condensable composite in sandwich restoration in 30 permanent molars. RMGI showed the least microleakage amongst all groups and supported the use of RMGI open sandwich technique in deep restorations. In another study by Loguercio et al, [16] gingival microleakage in 48 permanent molar teeth with class II restorations was evaluated comparing only composite restoration with open sandwich restorations using different materials (RMGI, compomer and a flowable composite). RMGI showed the least microleakage amongst the groups. Suwatviroj et al. [17] in their study compared the bond strength and fracture modes of 40 extracted primary molars restored with packable composite resin, RMGI, RMGI/packable composite resin sandwich restoration, or RMGI/packable composite sandwich restoration with K-14 bonding agent. No statistically significant difference was seen amongst these 4 types of restorations in terms of bond strength or fracture mode. Cannon [18] evaluated the efficacy of open sandwich restoration in clinical scenario for pediatric dental practice by comparing sandwich restorations with amalgam restorations and concluded that the open sandwich technique can be used in a pediatric dental practice showing good success rate. Atieh [19] evaluated the clinical performance and sustainability of stainless steel crown restorations and RMGI modified open sandwich technique in 186 primary molars. It was concluded that modified open sandwich restoration is an appropriate alternative to stainless steel crown in multi-surface restorations, especially where esthetics is of concern. Bona et al. [20] evaluated the sealing ability of conventional GI and RMGI used for sandwich restorations in 40 restorations in primary molars and examined the effect of acid etching of both these materials on microleakage of GI-composite resin interface. The results suggested that acid etching of GI before placing the composite resin did not show a significant improvement in the sealing capacity of sandwich restorations. RMGI was more effective in preventing microleakage at GI-composite-dentin interface. Fragkou et al. [21] evaluated the tensile bond strength of composite resin and RMGI in open sandwich restorations using tensile strength and strain tests in vitro. It was concluded that use of bonding agent improved the tensile bond strength of restorations.

Discussion

According to the literature, sandwich restorations with RMGI showed good clinical success. Advances in materials have made this technique relevant and usable even today. In a study carried out by Kleverlaan et al, [22] mechanical properties and compressive strength of GIs cured via various techniques were compared (chemically cured GI, ultrasonically activated GI or heat cured GI). The results showed that mechanical properties of GIs significantly improved after use of ultrasound or heat curing. An ultrasonically cured GI showed increased hardness, a decrease in softness of the top surface layer and negligible creep soon after placement, suggesting that the curing process may be accelerated immediately after ultrasonic activation.

Fourie and Smit [23] evaluated the effect of thermocycling, cervical position and use of different materials (GI set with ultrasound, conventional GI, light-cure GI and RMGI) on cervical microleakage of 200 proximal open-sandwich restorations in permanent molars. The results suggested that ultrasonically cured GI showed the least microleakage when the cervical margins of proximal restorations were placed in dentin.

Variations of open sandwich technique:

Pinheiro et al. [24] introduced a newer alternative to sandwich technique, namely simultaneous activation technique (SAT). In SAT, a glass ionomer cement is placed followed immediately by a bonding agent which is light cured before placement of composite resin. The requirement of setting of conventional GI or light curing of RMGI before placement of bonding agent and composite restoration is eliminated as such. In this study, bond strength and microleakage were evaluated using SAT and conventional sandwich technique. SAT and conventional sandwich technique did not show a statistically significant difference in bond strength or microleakage. It was concluded that SAT is a less complex, quicker, and feasible alternative for bonding of GI cements to composite resins in primary molars [24].

Knight [25] gave two variations for open-sandwich restoration technique namely composite resin co-cure technique and GI cement co-cure technique. The composite resin co-cure technique involved etching of enamel and dentin followed by placing a thin layer of RMGI and curing it. A second layer of RMGI was then applied immediately followed by the application of composite resin and both of them were cured together. The first layer of RMGI sealed the cavity while the second layer of RMGI reduced the polymerization stress of composite resin during curing. For cavities deeper than 2 mm, another layer of RMGI can be added to reduce stress between composite resin layers.

GI cement co-cure technique involves placement of conventional GI after etching of the cavity. GI is placed into the proximal box and as a base extending to dentinoenamel junction or just short of the cavo-margin. A layer of RMGI is immediately placed over it extending to the outer margin of the preparation. Composite resin is then placed as a final restoration followed immediately by curing. Composite resin is cured and undergoes polymerization shrinkage before the RMGI bond has cured, resulting in a stress free bond to tooth structure at the outer cavity margin. RMGI chemically bonds the composite resin to GI. Composite resin shows an exothermic reaction which in turns heats the conventional GI and starts a cascade setting reaction of GI in 20-40 seconds. According to a recent meta-analysis by Ortiz-Ruiz et al, [26] when success rate of different proximal tooth colored restorations was analyzed in primary molars after a follow-up of 24 months, it was found that RMGI was the most effective restorative material followed by RMGI placed beneath the composite resin (sandwich technique). However, only one study of sandwich technique met the inclusion criteria and hence it was concluded that more studies are required to assess the success of sandwich restorations in primary teeth (Figure 1).

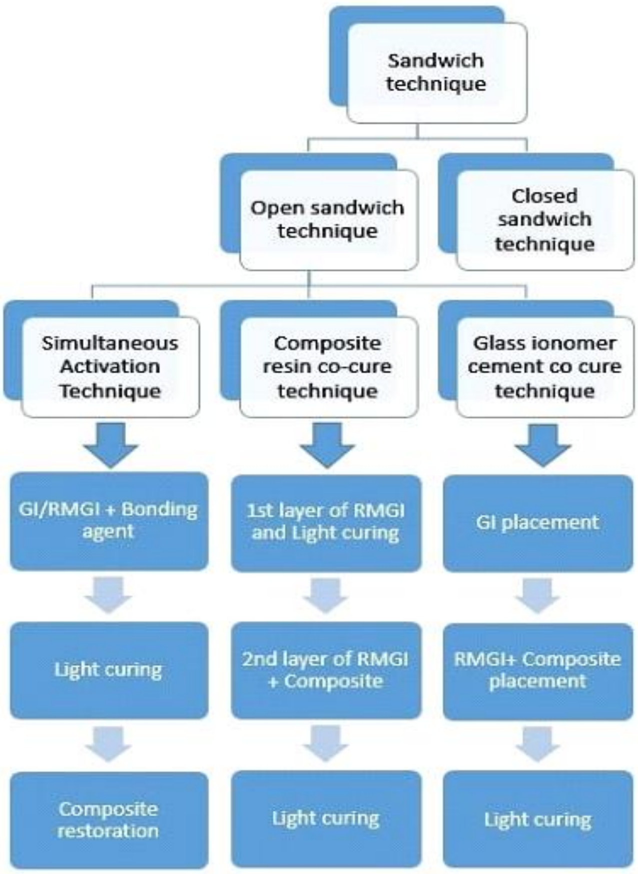

Figure 1. Modifications and Variations of Sandwich Technique

Conclusion

The sandwich technique has been introduced for over 40 years now. It is a commonly practiced technique in permanent teeth; however, there are very few studies done on primary teeth. Hence, more clinical studies are required using the sandwich technique and its modifications as a restorative protocol in primary teeth.

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