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Steps To Optimize Bond Strength to Molar Incisor Hypomineralization Affected Enamel

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Abstract

Children that have permanent first molar with molar-incisor hypomineralization (MIH) have high treatment failure. Bond strength of composite can be affected by the types of adhesives that are used. Deproteinization procedures can increase the bond strength and resin infiltration application with the MIH affected teeth needs to studied more to have meaningful results.

1. Introduction

Hypomineralization of molars and incisors is a developmental defect and it has a systemic origin which affects one / more first permanent molar, and it is frequently related with permanent incisors. It's generally defined with quite demarcated opacities and qualitative enamel defects because of reduced inorganic components in enamel with lessened mineralization. This defect can also create psychological, esthetic, functional and behavioral problems in children (Almulhim, 2021). MIH have different prevalence results changing between 2.5% to 40.2% (Kılınç, Çetin, Köse, & Ellidokuz, 2019). In 2001 Weerheijm and colleagues explained the term Molar Incisor Hypomineralization (MIH) as "demarcated, qualitative developmental defects of enamel affecting a minimum of one permanent molar with or without involvement of the incisors". At age eight first molars and incisors will possibly be erupted; because of that MIH can be determined more easily (Garg, Jain, Saha, & Singh, 2012). The European Academy of Pediatric

Dentistry guidelines are often used to diagnose MIH and include the following criteria: “clearly demarcated opacity in the occlusal and buccal surfaces of the crowns, white or yellow-to-brown discolorations, MIH defects at least 1 mm in diameter, the presence of hypersensitivity, the presence of atypical restorations (AR), and the need for extraction of permanent teeth” (Lygidakis et al., 2010). Atypical restorations involving uncommon surfaces of teeth like cusps can be noticed with irregular margins and opacity around the restorations. Children with MIH may experience severe tooth sensitivity to temperature changes making it difficult to maintain oral hygiene and further increasing the caries risk (Oyedele, Folayan, Adekoya-Sofowora, & Oziegbe, 2015). Defects in MIH affected teeth microscopically correspond deficient prism configuration with flabbily aligned hydroxyapatite crystal and bigger prism scabbards (Bozal, Kaplan, Ortolani, Cortese, & Biondi, 2015) with a remarkably decreased mineral intensity compared to healthy enamel possibly due to holded up proteins during enamel maturation (F. A. Crombie et al., 2013). As a consequence, MIH-affected enamel exhibits lower mechanical properties, with weaker rigidity and modulus of elasticity, against sound enamel (Mahoney, Rohanizadeh, Ismail, Kilpatrick, & Swain, 2004). Porous enamel structure and enamel degradation cause uncovered dentin with hypersensitivity and accelerated caries development (Americano, Jacobsen, Soviero, & Haubek, 2017). It is known that the enamel rigidity is decreased when the topic is about the adhesion of MIH related teeth (Chan, Ngan, & King, 2010) , and these teeth have erratic surfaces and irregular apatite (Xie, Kilpatrick, Swain, Munroe, & Hoffman, 2008) causing impairment of bonded margins / reduced retention. Micro-shear data reveal reduced adhesion to MIH teeth with porosities in resin-enamel interfaces (William, Burrow, Palamara, & Messer, 2006). Moreover enamel surfaces of teeth with MIH disorder have inhomogeneous crystalline parts (Baroni & Marchionni, 2011; Xie et al., 2008), high protein contents (Mangum, Crombie, Kilpatrick, Manton, & Hubbard, 2010) and these enamel surfaces would have erratic patterns after the acid application (Fagrell, Dietz, Jälevik, & Norén, 2010; Seow & Amaratunge, 1998). It is a known fact that hydroxyapatite can be improved by casein phosphopeptide — amorphous calcium phosphate (Baroni & Marchionni, 2011). Also removal of surface protein using 5% sodium hypochlorite were discussed (Mathu-Muju & Wright, 2006). In severe cases, also dentin is affected by MIH (Jälevik & Norén, 2000). Main findings in dentin were hypocalcemia, i.e. presence of interglobular dentin (Heijs, Dietz, Norén, Blanksma, & Jälevik, 2007).

2. Bonding Efficiency of Different Types of Adhesives to MIH Affected Teeth

William et al, claimed that two phased etching and rinsing adhesives may create insufficient microtags because of intercrystal porosity, and also etching with phosphoric acid possibly have a contribution to lower mineral levels when compared to self etch adhesives (William et al., 2006). In addition to that, self etch adhesives not having the rinsing step removes the possibilty of intervention of left water to the bond and rarefaction of primer which could dissolve in water. Self etch adhesives also give rise

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to better adhesion because of their chemical bonding with apatite. As an opposite point of view Krämer et al discovered better adhesion by an etch and rinse adhesive against to a self etch adhesive (Krämer, Bui Khac, Lücker, Stachniss, & Frankenberger, 2018). According to some researchers acotone that could be found in etch and rinse type can eliminate the left water from the enamel surface after acid application, so that it makes enamel more available to bond (Lygidakis, Dimou, & Stamataki, 2009). Just one researcher tried a universal adhesive along with etching step and found out lower adhesion against etch and rinse adhesives (Krämer et al., 2018). More researches should be done to agree on self etches being a better option to use at hypomineralized cases (take into account that hypomineralized teeth have more water in enamel, like in dentin).

3. Bonding and Icon

Resin infiltrant works with the principle of diffusing into the caries which are not cavitated. By that principle the porous canals get covered and acids can not get through the canals. Some researchers declared an irregular penetration (F. Crombie, Manton, Palamara, & Reynolds, 2014). As a result of researches, it has been found that there is no distinction if NaOCl was used after the teeth etched and before resin infiltration. Moreover, that it has been reported that penetration got worse (Krämer et al., 2018). Chay et al found out differrent bond strength values when using Icon® (Chay, Manton, & Palamara, 2014). According to a study in 2014, while NaOCl was applied together with Icon® resin infiltration following the acid application, enamel microhardness showed potentially more increased levels (F. Crombie et al., 2014). This might have a reasonable explanation; that the thickness of the enamel above the hypomineralized enamel was different at each time which was interrupting the penetration of resin, especially at the usage of phosphoric acid.

4. Effect of Deproteinization to Bonding

MIH-affected enamel has increased protein content which reduces the micromechanical adhesion. In endodontics, NaOCl has been used for dissolving organic material (Haapasalo, Shen, Wang, & Gao, 2014) and there is a belief that it increases enamel bond strength in hypocalcified amelogenesis imperfecta (Saroğlu, Aras, & Oztaş, 2006). Application time of NaOCl plays a critical role in the enamel bond strength. In a study carried by Saroglu et al it had been found that etching treated enamel surface with NaOCl increases the bonding strength by making protein degradation easier and by making enamel more penetrable (Saroğlu et al., 2006). Some researchers claim that teeth with MIH will have more bonding strength if NaOCl applied for 60s after the teeth etched. They also claimed that the composite restorations will stay longer at mouth (Chay et al., 2014; Ekambaram, Anthonappa, Govindool, & Yiu, 2017; Sönmez & Saat, 2017). On the other hand, some researchers reported that there was no significant increase in bonding strength (Gandhi, Crawford, & Shellis, 2012; Krämer et al., 2018). According to a study in 2018, when NaOCl was applied after acid application smaller test failure values were found but there was no improvement in enamel bond strength (Krämer et al., 2018). Only in this study at

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the first step, NaOCl was applied following by one layer of resin then a hydrophilic primer and hydrophobic adhesive. Despite of appliying NaOCl, difficulties can be seen at the infiltration of the hydrophobic adhesive to wet hypomineralized enamel; because of that, applying two coats of adhesives would be logical.

Using %5 NaOCl may cause some side effects such as; pulp inflammation especially in young permanent teeth or oral soft tissue damage in case of an undesirable contact (Ekambaram et al., 2017). An alternative agent would be profitable. Papacarie® can be that alternative agent which has the similar results with NaOCl (Bussadori, Castro, & Galvão, 2005).

5. Conclusion

At present, there are only few suggestions to have a solution to the bonding problem of teeth with MIH disorder. Within the confines of these studies:

Adhesion between composite and the teeth with MIH disorder have been found insignificantly different when comparison made between the self etch and etch-rinse adhesives. For etch and rinse adhesives, deproteinization after etching has been shown to increase bond strength; resin infiltration showed uneven penetration; however, pre-deproteinization after etching can increase the bond strength. More researches are necessary to improve the bonding strength of teeth with MIH disorder. As a result of laboratory studies it has been concluded that cohesive failures are frequent in teeth with MIH disorder. Clinical studies point out that failures tend to happen at the restoration margins. Adhesive strength is not the only mechanical property that effects the survival rate of the composite in teeth with MIH disorder. For this reason there is a need for studies which examine the hardness, fracture resistance and solubility of these teeth.

Conflicts of interest

The authors declare no conflicts of financial, economic or professional interests about ‘Processes Which Will Lead to Optimized Bond Strength to Molar Incisor Hypomineralization Affected Enamel’ study.

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