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Bonding to hypomineralized enamel – A systematic review

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ABSTRACT

The aim of this paper was to systematically analyze the published literature on bonding adhesive resin to hypomineralized enamel, in order to answer the questions: "Does resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel?" "Does self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives?" "Does deproteinization with 5% NaOCl before adhesive application procedure enhance bonding performance of resin dental adhesives to hypomineralized enamel?" Three electronic databases (Pubmed, Scopus and ISI web of Science) were searched to identify original studies that evaluated the bond achieved between resin adhesives and hypomineralized enamel. Only articles that met the specific inclusion criteria were included in the review. Among 6 studies included in this review, 4 studies that tested bond strength of resin composite to hypomineralized enamel showed significantly lower bond strength than that to sound enamel. Bonding was not compared between adhesives in 5 included studies as only one adhesive was used. Three out of four studies showed improved bonding performances when deproteinization was performed with 5% NaOCl to hypomineralized enamel before adhesive application. Resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel. There are no sufficient evidences to prove that self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives. Enamel deproteinization with 5% NaOCl before adhesive application procedure may enhance bonding performance of resin dental adhesives to hypomineralized enamel.

Contents

1. Introduction

Enamel is the outermost layer of the crown of a tooth that protects underlying dentin and pulp tissue [1]. Enamel does not have the capacity to regenerate or repair. It is composed predominantly of inorganic structure, making up to 96% by weight and the remaining 4%

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by organic structure and plasma [2]. A defect in the enamel could either be qualitative, leading to hypomineralization or quantitative, leading to hypoplasia. The two most common conditions that affect enamel are Amelogenesis Imperfecta (AI) and Molar Incisor Hypomineralization (MIH).

Among the inherited enamel disorders, AI is a well-recognized condition that affects both primary and permanent dentitions. AI falls into two main groups: hypocalcified and hypoplastic types [3]. Hypocalcified AI (HAI) is a qualitative defect, in which enamel has less mineral content; whilst hypoplastic AI is a quantitative defect, in which enamel is reduced in thickness or in extreme cases even complete absent of it. Wright et al. [4] and El-Sayed et al. [5] from their studies on ultrastructural analysis of sound teeth and teeth affected with HAI reported that there was a significant reduction in mineral content of enamel from teeth affected by HAI, when compared to teeth with sound enamel. Additionally, enamel of teeth with HAI may have 3–4% protein by weight compared with 0.5% for normal enamel [4,6].

Molar-Incisor Hypomineralization (MIH) is a condition of systemic origin that involves one to four first permanent molar teeth and often associated with affected incisors [7]. Etiology of MIH could be multifactorial, resulting from a variety of environmental factors acting systemically, including prenatal, perinatal and childhood medical conditions that affect the developing enamel, while an underlying genetic predisposition could not be excluded [8]. The clinical appearance of the teeth affected by MIH shows distinguished areas of enamel opacities with a change in translucency. The color of the affected enamel can vary from white to yellow or brown based on the extent of hypomineralization. In an affected person as a result of the variation in the extent of hypomineralization it is not uncommon to find one molar tooth with intact enamel opacity while the other molar tooth with enamel breakdown.

Enamel of teeth affected with MIH has altered inorganic and organic content. Accordingly, a mean 28% reduction in mineral content, 80% more carbonated apatite and 3- to 15- fold increase in protein content were found in enamel of teeth affected with MIH, when compared with enamel from sound teeth [9–11]. The hardness of MIH-affected enamel is also significantly lower than sound enamel [9]. The analysis of chemical profile of MIH-affected enamel has shown that Ca, P concentrations and mean Ca/P ratio are lower than normal; while C, Mg and K concentrations are higher [12,13].

Enamel bonding is performed in various clinical applications that include: (1) sealing of occlusal pit and fissures, (2) restoration of shallow cavitated caries lesions that includes preventive resin restorations, (3) restoration of large cavitated caries where the margins of the cavity still lie within enamel and (4) bonding of orthodontic brackets for fixed appliance therapy. Unlike bonding to normal enamel from sound teeth, bonding to enamel from teeth affected with HAI or MIH is very challenging, due to it's relatively reduced mineral content and increased organic content. Therefore, research studies on bonding dental adhesives to hypomineralized enamel have been conducted in order to compare (i) bonding to hypomineralized enamel and normal enamel, (ii) bonding to hypomineralized enamel using etch-and-rinse and self-etch adhesives, and (iii) bonding to hypomineralized enamel following deproteinization with 5% NaOCl and no deproteinization. NaOCl is a proven protein denaturant [14,15]. As the hypominerlized enamel has increased protein content that could interfere with bonding from adhesives, researchers [6] have suggested the use of 5% NaOCl as a deproteinization agent to remove the excess protein and enhance the bond strength to hypominerlized enamel.

Until date, there is no published review on bonding to hypomineralized enamel substrate, though it is a clinically relevant topic. Therefore, this systematic review was performed in order to answer the following questions that had tremendous clinical importance:

1. Does resin dental adhesives achieve inferior bonding to hypomineralized enamel when compared to normal enamel?
2. Does self-etch dental adhesives bond better to hypomineralized enamel when compared with etch-and-rinse adhesives?
3. Does deproteinization with 5% NaOCl before adhesive application procedure enhance bonding performance of resin dental adhesives to hypomineralized enamel?

2. Methods

This systematic review was reported following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement [16].

2.1. Search strategy

Clinical and laboratory studies that evaluated the bond achieved between resin adhesive and hypomineralized enamel were included. The electronic databases searched for identifying the relevant studies included PubMed, Scopus, and Web of Science. The key words and their sequence used for searching through electronic databases were:

#**1** hypomineralization OR hypomineralized OR hypocalcified OR MIH OR amelogenesis imperfecta
#**2** enamel OR tooth OR teeth
#**3** Bonding OR bond OR adhesion
#**4** (#1) AND (#2) AND (#3).

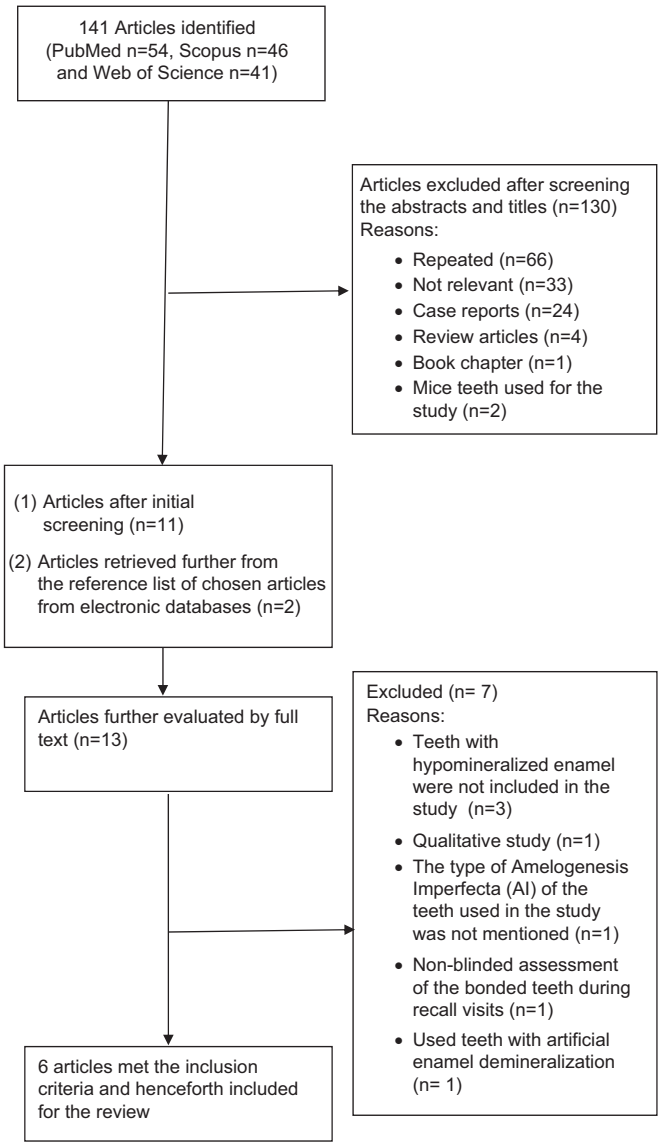

Fig. 1. Flow chart of the articles selection process.