Iranian Journal of Medical Hypotheses and Ideas

Original article

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Application of bonding system as a sub-base material following electrosurgical pulpotomy treatment in primary teeth: a novel technique

Alireza Sarraf Shirazi[1], Minoo Rezaifar[2], Maryam Talebi[1], Ali Mortazavi[3] and Katyoon Safari Malekabadi[2]

Address:
[1]Assistant Professor, Department of Pediatric Dentistry and Dental research Center, Mashhad University of Medical Sciences, 91735, Mashhad, Iran
[2]Postgraduate Student, Department of Pediatric Dentistry and Dental research Center, Mashhad University of Medical Sciences, 91735, Mashhad, Iran
[3]Postgraduate Student, Department of Oral and Maxillofacial Surgery and Dental research Center, Mashhad University of Medical Sciences, 91735, Mashhad, Iran

Corresponding author:
Alireza Sarraf Shirazi, DDS, Pediatric Dentist.
Phone: +98-511-8829501 Ext. 380
Fax: +98-511-8829500
E-mail: Sarrafa@mums.ac.ir

Received: 23 Nov 2008
Accepted: 21 Dec 2008
Published: 20 May 2009
Iran J Med Hypotheses Ideas, 2009, 3:12

Abstract

Carious primary teeth are still a great problem in many countries. Maintaining these teeth, which play a significant role in chewing, guiding the permanent teeth to erupt normally and keeping the ideal dental arch size, is very important. The most common treatment of the deep carious primary teeth is pulpotomy. Many techniques and sub-base materials have been suggested for this purpose.

All traditional sub-base materials have been found to have different percentages of failure. Bonding systems are widely used in dentistry for tooth restoration. Their greatest advantage is providing better seal in the tooth-restoration interface, which is the primary goal in restorative dentistry. The authors' suggestion is to use these materials as a sub-base agent subsequent to the electrosurgical pulpotomy technique. Bonding systems are easy to use, time efficient, biocompatible, do not need sealing pressure, and additionally provide an ideal seal.

Keywords
Pulpotomy, Tooth Deciduous, Dentin-Bonding Agents, Electrosurgery

Introduction

Humans develop two sets of teeth. The first set is referred to as primary teeth (also called deciduous teeth) and the second, permanent teeth. Unfortunately, dental caries is still one of the most widespread diseases among humans, and the most prevalent chronic disease in children (1). Carious primary teeth in children may be a reason of toothache, infection and abscess. Also they may cause severe disturbances in nutrition, growth and development, well-being, aesthetic, self-confidence and quality of life (2). Caries prevalence in primary teeth has been reported between 41-89%, in different populations (3-5).

Due to a very close relation between the primary tooth root and the dental germ of the permanent successors (Figure 1A), a primary tooth infection may cause severe hypoplasia in the permanent tooth (so called as turner's hypoplasia) (6). Also, extraction of these carious teeth may result in many complications, such as difficulty in chewing, loss of normal occlusion and interdental space, crowding and ectopic eruption of the permanent teeth (7). Therefore, treatment and maintenance of carious primary teeth is one of the most important goals in dentistry.

Approximately 75% of primary teeth with deep caries have been found to have pulpal exposure. These teeth require pulp therapy, with pulpotomy being the most common form (8). For many years, researchers have introduced three pulpotomy modalities for primary teeth: I) Devitalization (Formocresol, Glutaraldehyde, Electrosurgery), II) Preservation (Ferric sulfate, Calcium hydroxide (Ca(OH)2), Mineral Trioxide Aggregate (MTA), laser) and III) Regeneration (Indirect pulp treatment, Bone Morphogenetic Proteins (BMPs), Collagen) (8,9). Many scientists have focused their studies on these methods. But almost all of them have had a rate of failure (Table 1).

After performing the pulpotomy technique (Figure 1B), the floor of the pulp chamber should be covered with a pulp capping material, which is referred to as sub-base (otherwise known as dressing agent). Some of the desired properties of sub-bases are: ideal seal, adhering to dentin, minimum sealing pressure, easy handling, short setting time and biocompatibility (8,10). Also, occupying minimum space of the pulp chamber in order to maintain more room for the restorative material may be considered as an important advantage.

It should be noted that a material with all of the mentioned properties has not yet been found, and none of the existing ones have been regarded as ideal (10,11).Traditionally, Zinc oxide-Eugenol (ZoE) cement has been the most popular sub-base agent. However, calcium hydroxide and MTA are also recently being used. BMPs and Transforming Growth Factor beta (TGFβ) are under investigation (8,10,12).

Disadvantages of common sub-bases

None of them have shown an ideal success rate especially in long term follow-ups (Table 1). They all occupy most of the space in the pulp chamber (Figure 2A), need sealing pressure and are difficult to handle. Most of them have a long setting time (ZoE, MTA), and some of them are too expensive to use in general practice (MTA, BMPs & TGFβ) (8,11-19).

Pulpotomy failure signs

Based on several studies, the most common signs of pulpotomy failure are: internal or external root resorption, periapical radiolucency, and in acute forms, abscess or fistula (11). There is no doubt that penetration of microorganisms through the sub-base material is responsible for all of these failures (10,20). Hence, finding a sub-base with a better seal and devoid of the mentioned disadvantages is a major objective.

Hypothesis

The authors believe that the application of bonding materials as a sub-base agent subsequent to pulpotomy treatment will be ideal. The roll of bondings is to infiltrate into dentine, and form an impermeable hybrid layer. Consequently, they provide acceptable seal, and will inhibit bacterial penetration into the pulp canals (Figure 2B). They need no sealing pressure, occupy no space in the pulp chamber, are easy to handle, have a short setting time (the light curing period is only 20-40 sec) and are of a reasonable price.

History of bonding systems

The bonding system, also called the adhesive resin, consists primarily of hydrophobic and hydrophilic monomers. The major role of the adhesive resin is providing better seal in the tooth-restoration interface by stabilizing the hybrid layer and forming resin tags (21). In 1975, the first commercial bondings were presented. Introduction of the second generation to the market was in the early 1980s. However, both generations were disappointing in clinical practice. The third generation bondings were introduced in the late 1980s. They were able to remove the smear layer and let the resin penetrate into the dentin. Then came the total-etch adhesives that consist of the fourth and fifth generations. Both fourth and fifth generations had good in-vitro results of bond strength and seal (22).

In order to reduce clinical problems with total-etch systems (rinsing & drying), the self-etch bondings were introduced (sixth and seventh generations).They are more user-friendly and cause minimum postoperative sensitivity (22). The seventh generation consists of single-component, one-step self-etch adhesives (21,23). Therefore, they eliminate the additional mixing step, which was obligatory in the sixth generation. Some examples are: PromptL-Pop (3M ESPE), One Up Bond F, Touch and Bond, iBond and S3 Bond. Nowadays, fillers are added to many bondings. It seems that filled resins may provide stress relief at the tooth-restoration interface (21,22). Also, the filler particles in the bonding resin improve the thickness of the adhesive layer that results in the reduction of dimensional changes (23). These materials are widely used for crown restoration in both primary and permanent teeth. Their great advantage is that they provide better seal compared to other materials (24).

Evaluation of the Hypothesis

The success or failure of a sub-base material, which is evaluated both clinically and radiographically, usually depends on the reaction of the vital pulpoperiapical complex. Thus, in vitro studies are not useful, and only animal or human studies have to be designed.

There are three major problems to study primary teeth in animal models: 1- impossibility of long term follow-ups due to the early exfoliation of primary teeth, 2- bruxism or wearing of teeth, and finally 3- the small size of these teeth in animals. As a result, it seems that conducting animal studies for primary teeth are not useful (25). As bonding systems are well tolerated by the pulpodentinal complex, our suggestion is designing the following human study.

Suggested technique for pulpotomy of primary teeth

All studies in children need special attention; therefore, among the available suggested techniques for pulpotomy, a very safe modality ought to be selected. The authors' recommendation is devitalization by electrosurgery. Its success rate is comparable to the gold standard (Formocresol), but unlike it, it neither requires a chemical agent, nor has the possible toxicity (15). Also, it can be done in a few seconds, which is regarded as a great advantage in pediatric dentistry (9,15,26-29). It should be noted that there are a few concerns regarding the biocompatibility of bonding systems for the vital pulp. And it is the reason why the authors have selected the devitalization method. Although these materials are well tolerated by the pulp and dentin (21), the devitalized pulp of the primary teeth will definitely present no reaction.

The pulpotomy procedure

1) Administration of local anesthesia and placing the rubber dam.

2) Removing all superficial dental caries and the overhanging enamel.

3) Preparing access cavity and amputation of the coronal pulp (Figure 1B).

4) Irrigation of the pulp chamber and placing moistened cotton pellets until hemostasis becomes apparent (8,12).

5) Devitalizing the pulp by placing the electrosurgery dental electrode about 1-2 mm over the tissue until the pulpal stumps appear dry and darkened (15).

6) Cleaning the pulp chamber using sterile moistened cotton pellets.

7) Placing a self- etch, one bottle (seventh generation) filled bonding agent on the floor and walls of the pulp chamber by means of a microbrush.

8) Polymerizing the material using a high intensity light curing system from the least distance.

Finally, the crown restoration can be done by any desirable material.

Our short term follow-up on 50 cases showed great successful results (100%). However, larger studies with longer follow-up periods are highly advised.

Discussion

Despite preventive programs for oral diseases, dental caries is still a world-wide problem and many children suffer from it. Pain, infection and daily activity limitations are a few complications caused by this disease (30). In severe cases, it may result in malnutrition and weight loss. Attempts to maintain the carious primary teeth will lead to better oral health and consequently, better general health (1). It should be reminded that dental fear in children is very common, so time saving in pediatric dentistry is a must. Any candidate method and material in this area has to be easily done and should have a short working time (31).

Pulpotomy, which was first introduced by Sweet in 1904, is the most common treatment of the deep carious primary teeth (10). Many researchers have focused their studies on different techniques and modalities for this treatment (9,26-29). After performing pulpotomy procedures and pulp chamber amputation, a sub-base material is needed to cover the pulp stumps. This material should have several properties, of which, seal, short setting time and efficacy in a thin layer are the most important ones (10,12,21).

Few sub-base materials have been introduced in dentistry. All of the common sub-base materials have several disadvantages. They have long setting time and difficult handling methods. Also, most of them present percentages of long-term failure due to the penetration of oral fluids and bacteria.

The authors believe that application of a seventh generation bonding agent as a sub-base, may achieve the ideal properties for pulpotomy of primary teeth.

In comparison with traditional ones, these materials are beneficial in the following ways: They occupy less space in the pulp chamber (reserve more room for the restorative material) (Figure 2B), need no sealing pressure, are time efficient, easy to handle, and of course, provide ideal seal.

Conclusion

Application of a bonding system as a sub-base material, following pulpotomy treatment, may result in a higher success rate for maintaining primary teeth. The final goals of preserving primary teeth in children are better oral health and of course, better nutrition, growth and development.

Acknowledgements

The help of Ghazaleh Khojasteh in hand painting, scanning and setting up the figures is gratefully acknowledged.

Table 1. Success rate of different pulpotomy modalities based on several reported studies. Pay attention to sub-base material and follow-up periods.

Investigators	Success Rate	Sub-base material	follow up period (month)
	Formocresol		
Agamy et al, 2004 [13]	90%	ZoE	12
Huth et al, 2005 [16]	85%	ZoE	24
Bahrololoomi et al, 2008 [14]	96%	ZoE	9
Sonmez et al, 2008 [19]	76.9%	ZoE	24
	Ferric Sulfate		
Dean et al, 2002 [15]	84%	ZoE	6
Bahrololoomi et al, 2008 [14]	84%	ZoE	9
	Calcium Hydroxide		
Sonmez et al, 2008 [19]	46.1%	Ca(OH)2	24
Moretti et al, 2008 [18]	36%	Ca(OH)2	24
	MTA		
Sonmez et a, 2008 [19]	66.6%	MTA	24
Nematollahi et al 2006 [11]	69.2%	MTA	12

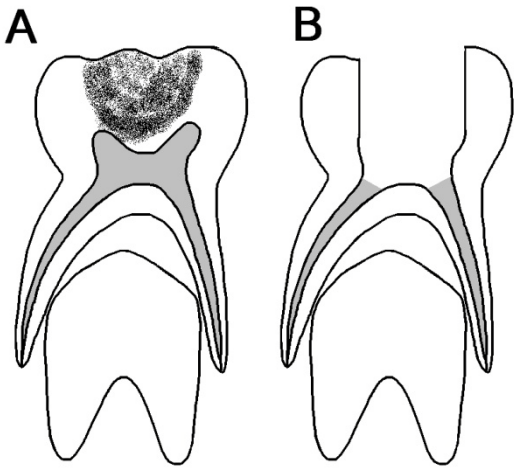

Figure 1. A carious primary tooth (Note to the close relation between the primary tooth root and the permanent germ). B Performing pulpotomy technique (caries removal, access preparation, pulp chamber amputation).

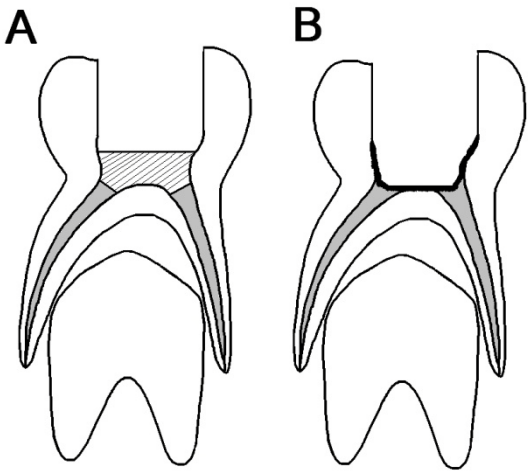

Figure 2. A conventional sub-base. (Note that almost all space of pulp chamber has been occupied). B Application of a bonding agent instead of conventional sub-bases. (No space of the pulp chamber is occupied)

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