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A LITERATURE REVIEW ON THE MANAGEMENT OF THE EXPOSED VITAL PULP IN PRIMARY DENTITION

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1. Abstract

Many materials have been used as a medicament in the treatment of exposed vital pulp in primary dentition some of them recently presented in the market, which are used in the treatment of exposed pulp in the deciduous tooth, which make the dentist confused about which materials are better if used and what is the correct way to use it. In this research, I will touch on this topic to give a brief overview of materials are available now and the advantages and disadvantages of it in order to make it easier for the dentist to understand the material and how to use it and the possibility of searching for it through the references.

Keywords: EXPOSED, VITAL PULP PRIMARY DENTITION,

2. Introduction

The management of the exposed vital pulp in primary teeth has changed recently and new materials have been introduced (Rodd et al, 2006). The primary goal of the management of the primary dentition with deep caries, is to preserve the teeth vitality and minimise the trauma to the pulp as much as possible (Fuks, 2002; Rodd et al, 2006). Preserving the teeth vitality maintain the primary dentition in an intact state until the permanent successors erupt thus preserving arch integrity (Fuks, 2002). Maintaining pulp vitality also reduces problems with mastication, speech, and/or esthetics (Fuks, 2002).

The mechanism of action of the vital pulp therapy is depending on the ability of the tooth to heal by forming a dentin-like matrix, the tertiary dentin (Baume, 1980) There are two treatment options to treat the exposed vital pulp in primary teeth; direct pulp capping (DPC) or pulpotomy (Tziafas, 2004; Fuks, 2008). Pulpotomy is the essential treatment option to treat exposed vital primary teeth (Curzon et al, 1996; Rodd et al, 2006).

3. How to differentiate between vital and non-vital pulp in exposed primary teeth?

In the literature, electric and thermal pulpal sensitivity tests are not appropriate for primary molars (Curzon et al, 1996; Rodd et al, 2006). So to determine whether the tooth is vital or not, a careful history, a proper clinical and radiographic examination should be considered of the tooth (Farooq et al. 2000; Fuks. 2002; Camp, 2008; Curzon et al, 1996) Firstly to determine the vitality of the tooth the patient have to confirm whether the tooth is painful or not and distinguish if it is provoked or spontaneous (Camp, 2008). Provoked pain occurs when the pain is initiated by the following causative stimuli (thermal, mechanical, or chemical irritants) and stops when stimuli is removed, teeth with provoked pain can be treated with vital pulp therapy (reversible pulpitis) (Farooq et al, 2000). Spontaneous pain (throbbing pain that occurs without stimulation) and continues pain (pain initiated by the stimuli and continues after removing of the stimuli) are indicative of irreversible pulpitis, or pulp necrosis which is contraindicated for vital pulp therapy (Camp, 2008) The tooth with spontaneous pain might be vital or non-vital, to make sure whether the tooth is vital or not, the characteristic of bleeding (colour, amount) at the exposed site is the key to distinguish between reversible and irreversible pulpitis (Curzon et al, 1996). If the bleeding is bright red and can be controlled within four minutes by applying a gentle pressure using a saline wetted cotton pellet it indicates reversible pulpitis and the tooth can be treated with vital pulp therapy (Rodd et al, 2006). Whereas if the bleeding is excessive, appears deep purple and cannot be controlled within four minutes it is an indication of a hyperemic, inflamed radicular pulp and these teeth are candidates for either pulpectomy or extraction (Rodd et al, 2006). Even though if there is no bleeding at the site of exposure, there might be necrotic pulp (Rodd et al, 2006).

4. Special investigations prior to vital pulp therapy:
    - The patient's medical history (susceptibility to infective endocarditis).
    - Caries risk assessment.
    - Patients cooperation.
    - The difference between primary and permanent teeth.
    - Preoperative Radiographs should be performed (Rodd et al, 2006).
5. Direct pulp capping (DPC):

This technique is indicated when the pulp exposure is only 1mm (referred to as a pinpoint exposure) in asymptomatic teeth and the tooth exposed by trauma rather than the tooth exposed by dental caries because of less pulp contamination (Fuks, 2005; Rodd et al, 2006). The rationale behind this

technique is to stimulate the dentin formation at the site of the exposure and thus preserve the tooth vitality (Fuks, 2005; Rodd et al, 2006).

Generally, DPC is not recommended for the primary teeth due to the poor prognosis and root resorption (Rodd et al, 2006; Fuks, 2005). However, Tuzuner et al (2012) use this technique to treat the exposed vital primary molar using calcium hydroxide. This study though had a small sample size, comparing four groups that received different types of antiseptic prior to use of calcium hydroxide as a capping material (Tuzuner et al., 2012). Moreover, the use of the calcium hydroxide in this study is contraindicated because putting calcium hydroxide directly on the pulp tissue leads to root resorption. However, more studies are need to be done to proof this technique is appropriate

6. Pulpotomy:

The American Academy of Pediatric Dentistry (2007) described pulpotomy as a procedure which includes amputation of the coronal pulp tissue by using a sharp spoon excavator or using a large size round bur with a low speed handpies and treat the remaining vital radicular pulp tissue with a suitable dressing that will promote healing and preserve vitality of the tooth (Rodd et al, 2006). Pulpotomy aim to preserve the tooth by preserving the radicular pulp tissue, and therefore, avoid pain and inflammation (Fuks, 2002; Rodd et al, 2006)

6.1. Indications of pulpotomy:

Pulpotomy is only indicated for teeth with no signs and symptoms of irreversible pulpitis or pulp necrosis based on a good history followed by a proper clinical and radiographic examination (Spedding, 1968; Rodd et al, 2006)

6.2. Contraindications of pulpotomy:

1. Spontaneous pain.
2. Pain on percussion or palpation.
3. Fistula, swelling in periodontal tissues.
4. Abnormal tooth mobility.
5. Tooth unrestorable.
6. Initially unsuccessful hemorrhage control.
7. Presence of exudate or pus at the exposure site.
8. Inter-radicular or periapical radiolucency.
9. Thickening or widening of the periodontal ligament space
10. Internal and external root resorption.
11. Calcification in pulp tissue.

12.physiological root resorption of more than one-third (Smith, 2000; Hill, 2007)

6.3. The pulpotomy procedure:

Local anesthesia is administered. A rubber dam isolates the tooth from the oral environment (Curzon et al, 1996). The caries is removed by using a low speed round bur (Curzon et al, 1996). All peripheral caries should be removed (caries on the lateral wall) before the pulp is exposed. To get to the coronal access to the pulp chamber use a high-speed diamond bur with water coolant to prevent heat generation, and amputate the coronal pulp tissue with a round bur in a low-speed handpiece or using a sharp large spoon excavator to minimize the trauma to the pulp (Curzon et al, 1996; Rodd et al, 2006). Control the bleeding by applying gentle pressure with a sterile wet cotton pellet to the pulpal stumps (Curzon et al, 1996; Huth et al, 2005). The bleeding should be controlled within 4 minutes (Rodd et al, 2006; Hui-Derksen et al, 2013). Caution should be taken to avoid the use of vasoconstrictor or haemostatic agent (Curzon et al, 1996; Rodd et al, 2006). Since observing the ability to achieve initial haemostasis it is essential for the dentists in assessing the extent of inflammation of the pulp tissue and the radicular pulp status (Curzon et al, 1996; Rodd et al, 2006). If there is uncontrollable bleeding make sure that the bleeding is not from bifurcation area by performing another radiograph otherwise the tooth indicated for extraction (Rodd et al, 2006). Clean and dry the cavity and apply the dressing material, filled with zinc oxide euogenol (Rodd et al, 2006). As a final restoration use stainless steel crown or amalgam or any other material that provide a good seal to prevent the leakage (Rodd et al, 2006). Post-operative radiograph is very important to assess the procedure (Rodd et al, 2006).

Pulpotomy procedure is generally completed in a single stage, however, Curzon et al (1996) indicate a two stage pulpotomy technique when the patient is uncooperative or the local anesthesia is not working very well.

The most appropriate or suitable pulpotomy dressing material is still controversial (Srinivasan et al, 2006). Materials used as pulpotomy medicament are formocreasol, glutaraldehyde, electrosurgery, ferric sulfate, calcium hydroxide, mineral trioxide aggregate, calcium-enriched mixture, lasers, ledermix, bone morphogenic proteins and collagen solutions. The mechanism of action of these materials can either be devitalization, preservation or regeneration. However, some of them have a combination of these properties (Rodd et al, 2006).

6.4. Materials used in pulpotomy

6.4.1. Formocresol (FC)

Despite the fact that formocresol (FC) is a carcinogen and a mutagen (Lewis and Chestner, 1981) almost all the research articles use FC as a standard dressing pulpotomy material and they compare FC with other dressing materials (Huth et al, 2005; Ansari and Ranjpour, 2010). FC is still a preferable pulpotomy technique because of the success rate. Moreover, some studies have reported that the early exfoliation of primary teeth followed pulp treatment with FC at a high rate ranged from 38%-47% (Farooq et al, 2000; Fuks et al, 1990).

A recent study highlighted that the use of formocresol no longer accepted and they recommended the use of 1-5 diluted formocresol instead of full strength formulation with the same clinical efficacy and 20% of its toxicity if it's necessarily (Ruby et al, 2013)

6.4.2. Glutaraldehyde

The use of 2% glutaraldehyde results in a success rate 83% over two years follow. However, bone resorption is the most common cause of failure of using 2% glutaraldehyde (Fuks et al, 1990).

6.4.3. Electrosurgery

Electrosurgery is defined as a non-pharmacological haemostatic pulpotomy approach (Curzon et al, 1996; Rodd et al, 2006). The rationale behind this technique is to preserve health of the radicular pulp tissue by producing a layer of coagulative necrosis over it, but the problem with this technique is that electrosurgery will not reduce inflammation (Rodd et al, 2006).

6.4.4. Lasers

The mechanism of action of this technique is devitalization of the pulp tissue. However, few researches have shown the use of lasers in human primary molar pulpotomy (Curzon et al, 1996; Rodd et al, 2006; Huth et al, 2005). Lasers was significantly better compared with FC with clinical success rate of 97%, and radiographic success rate of 94% with no effect on the permanent successors (Liu, 2006). However, more research needs to be done regarding the use of laser and electrosurgery and its appropriate methods (Curzon et al, 1996).

6.4.5. Calcium hydroxide

Calcium hydroxide is not the material of choice to use as a pulpotomy dressing (Mohamed, 2008) due to its solubility over time and multiple defects in the dentin bridge formed under the calcium hydroxide, which permit bacteria and fluid penetration into the tooth, consequently lead to pulp irritation, internal resorption, and finally loss of the tooth (Faraco and Holland, 2001; Smith et al, 2000). Success rate of calcium hydroxide appeared to be lower due to bone resorption compared to FC, ferric sulfate, lasers and mineral

trioxide aggregate (Rodd et al, 2006; Huth et al, 2005; Curzon et al, 1996). That means the calcium hydroxide is not a good pulpotomy dressing material.

6.4.6. Ferric sulfate

Ferric sulfate is one of the inexpensive dressing materials used for pulpotomy with a good success rate (Fuks, 2002; Fuks, 2005; Srinivasan et al, 2006). Its mechanism of action act as a haemostatic agent, stopping the bleeding and prevent clot formation by its chemical reaction with blood (Rodd et al, 2006). Ferric sulfate alone is not enough to provide a good seal and always needs a lining material such as calcium hydroxide or zinc oxide-eugenol after its application (Smith et al, 2000; Mohamed, 2008).

Ferric sulfate has been reported to be better than FC with clinical success rate ranged from 99%-100% and radiographic success rate ranged from 80%-86% (Smith et al, 2000; Huth et al, 2005).

A study compared calcium hydroxide with zinc oxide-eugenol as a base following ferric sulfate pulpotomy and concluded that calcium hydroxide is not recommended as dressing material in the pulpotomy procedure even after ferric sulfate was applied (Mohamed, 2008)

6.4.7. Mineral trioxide aggregate (MTA)

This material is biocompatible, have good sealing ability, promote pulp and periodontal ligament repair, stimulate hard tissue formation and is non mutagenic (Faraco and Holland, 2001; Caicedo et al, 2006; Camp, 2008). Disadvantages of MTA are it takes about four hours to set, needs water during the setting reaction and is more expensive than ferric sulfate and sodium hypochlorite (Caicedo et al, 2006; Fuks, 2005).

Several studies support the use of MTA for pulpotomy procedure in primary teeth (Ansari and Ranjpour, 2010; Caicedo et al, 2006; Witherspoon, 2006; Fuks, 2005; Srinivasan et al, 2006). With success rate 95% compared to 90% for formocreasol over two years follow up (Ansari and Ranjpour, 2010). It seems to be good and easy to use as pulpotomy medicament.

6.4.8. Three or five percent sodium hypochlorite (NaOCl)

Some studies showed that 3% or 5% sodium hypochlorite (NaOCl) as a pulpotomy medicament can be used successfully (Ruby et al, 2013; Vargas et al, 2006) with clinical success rate 100% at 6 and 12 months follow up, and the radiographic success is 86% - 80% at 6 to 12 months respectively (Ruby et al, 2013) whereas Vargas et al (2006) have shown a 100% clinical success and 79% radiographic success for NaOCl. However, more long term studies needed to be done to show that sodium hypochlorite is a good medicament.

6.4.9. Steroidal antibiotic paste (Ledermix)

This material is safer to use as a desensitizing medicament in two visit pulpotomy procedure, with anti-inflammatory and analgesic properties. However, not enough research has been done to show use of ledermix as a pulpotomy agent in primary teeth (Rodd et al, 2006)

6.4.10. Calcium-enriched mixture

Calcium-enriched mixture cement is a relatively new material that has been presented as a dressing material. It has been used in multiple situations in primary as well as in permanent teeth from which direct pulp capping and pulpotomy with good results (Asgary and Ahmadyar, 2013). However, more research needs to be done about the effectiveness of the calcium-enriched mixture.

6.4.11. Reinforced zinc oxide eugenol (R.ZOE)

A recent study performed pulpotomy technique without dressing material and the reinforced zinc oxide eugenol (R.ZOE) was directly applied on the pulp tissue (Hui-Derksen et al, 2013). This study showed that R.ZOE can be used successfully as a dressing material (Hui-Derksen et al, 2013). However, the question arises whether the R.ZOE is safe enough to put on the pulp tissue directly? This study was retrospective study and hemostasis achieved by using a dry cotton pellet (Hui-Derksen et al, 2013). In fact, the use of dry cotton pellet to achieve the hemostasis leads to more trauma to the pulp tissue and also the use of eugenol directly on vital pulp tissue may lead to internal resorption (Smith et al, 2000). From my point of view more randomized studies needed to be done regarding the actual histological effect of the R.ZOE on the pulp tissue.

6.4.12. Collagen and bone morphogenic proteins:

There are two new materials that might give us promising results which are collagen and bone morphogenic proteins but still more studies need to be done on human teeth; however, what have been done so far are only studies on animals (Srinivasan et al, 2006).

6.5. Factors effect on the survival rate of pulpotomised primary teeth:

Factors that significantly have an effect on the survival rate of pulpotomised primary teeth are the tooth vitality and the presence of radiolucency associated with the tooth at the time of the treatment (diagnosis accuracy) (Hill, 2007) however, in Hill's study (2007) pulpotomy technique was not performed with the same material for the whole sample group and pulpotomy was undertaken in non-vital teeth in patients of 11-12 years of age. Normally pulpotomy is not for treatment of non-vital teeth and also the age group of the participants of the study was at or too near the exfoliation time. Therefore, this study does count as successful pulpotomy.

Final restorative material plays an important role in the success of the vital pulp therapy (Holen et al, 2002; Farooq et al, 2000). Holen et al (2002) have compared the stainless steel crowns (SSC) with the amalgam as a final restoration in the teeth treated with formocreasol pulpotomy, the success rate of teeth restored with SSC, higher than that of amalgam. If you looked at the results was not too much difference compared to recent study the success rate of the FC pulpotomy which was too low 86% (Holen et al, 2002; Igna A, 2021). Moreover, a study by Farooq et al (2000) showed that SSC placed immediately after FC pulpotomy procedure significantly increased its success. Recently Igna A, 2021 and Guelmann et al (2004) have found that adhesive restorations can provide an optimum marginal seal and therefore, avoid leakage in pulpotomized primary molars.

7. Conclusion:

Pulpotomy is the treatment of choice to treat the exposed vital primary teeth using mineral trioxide aggregate or ferric sulfate. Although some studies have shown sodium hypochlorite successfully used as pulpotomy medicaments. More research needs to be done to increasing our demand for perfect pulpotomy material with prolonged success rate.

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مراجعة الأدبيات حول إدارة اللب الحيوي المكشوف في الأسنان الأولية

سامية الهادي سلامة

قسم التقويم وطب أسنان الأطفال والطب الاجتماعي، كلية طب وجراحة الفم والأسنان ، الجامعة الأسمرية الاسلامية زليتن، ليبيا

المستخلص:

العديد من المواد والتي تم استخدامها كدواء في علاج اللب الحيوي المكشوف في الأسنان اللبنية ، بعضها تم طرحه مؤخرًا في الأسواق ، مما يجعل طبيب الأسنان في حيرة من أمره أي المواد أفضل إذا استخدم وما هي الطريقة الصحيحة لاستخدامه. في هذا البحث سوف أتطرق إلى هذا الموضوع لإعطاء لمحة موجزة عن المواد المتوفرة الآن مزاياها وعيوبها ليسهل على طبيب الأسنان فهم المادة وكيفية استخدامها وإمكانية البحث عنها باستخدام المراجع.