

Pulp Treatment in Deciduous Teeth

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Abstract

Retaining deciduous teeth in function until their natural exfoliation is absolutely necessary. Premature loss of milk teeth might lead to short-term effects like problems in eating and speaking and long-term effects like misalignment of permanent teeth and increased risk of malocclusion later on. Pulp injuries in primary teeth due to caries and trauma may threaten pulp vitality, so appropriate treatment such as Vital Pulp Therapy or Root Canal Treatment may be required. Vital pulp therapy (VPT) is a method of conserving deciduous teeth. Vital Pulp Therapy includes three therapeutic approaches: Indirect pulp capping (IPC) for teeth with cavities limited to the dentin and reversible pulpitis; direct pulp capping (DPC) for healthy vital teeth with pinpoint mechanical or traumatic pulp exposure and pulpotomy which too is considered in cases with pinpoint pulp exposure in a vital tooth [1].

Aim of Work: In this review, we aim to review the various therapeutic approaches that can be used as a part of vital pulp therapy in primary teeth to preserve their healthy pulp tissues, their indications, objectives, and the biocompatible materials that can be used for these procedures.

Methodology: This review is using a comprehensive search of PUBMED from 1981 to 2016.

Conclusion: We can conclude that Indirect Pulp Capping is a successful and favorable procedure for treating primary teeth with deep caries that have no exposure of pulp, provided the pulp is healthy or has reversible pulpitis. It is a low-cost procedure with good long-term success and is better at retaining the primary teeth until their natural exfoliation. Direct Pulp capping is still a controversial technique for primary teeth. However, the introduction of new biomaterials has challenged this theory, but the long-term evaluation is still required. A pulpotomy is the most common treatment for pulp exposure in symptom-free primary molars with a healthy pulp and appears to have good success rates [1,7,12].

Keywords: Vital Pulp Therapy; Indirect Pulp Capping; Direct Pulp Capping; Pulpotomy

Introduction

Humans are diphyodonts, i.e., they have two successive sets of teeth, which we call the primary and the permanent teeth. Primary set of teeth is important in a child's life as it helps them to speak, chew their food, and also contributes to facial esthetics. Primary dentition conserves the integrity and length of the dental arches, finally aiding in guiding the permanent successors to their right positions in the mouth. The primary incisor teeth are functional in the mouth for approximately five years, during which the primary molars are functional for approximately nine years. Therefore it is necessary to preserve the primary teeth in an intact condition until the eruption of the permanent successor. Maintaining healthy primary teeth is essential to a child's overall oral and general development [2].

Premature loss of deciduous teeth can cause malocclusion in addition to functional and esthetic problems. Early loss of teeth might lead to short-term effects like problems in eating and speaking and long-term effects like malalignment of permanent teeth and increased risk of malocclusion later on [3].

The pulp in primary dentition is histologically similar to permanent teeth and may be affected by caries, restorative procedures, and trauma. Pulp injuries due to caries and trauma may threaten pulp vitality, so appropriate treatment such as Vital Pulp Therapy or Root Canal Treatment may be required [1].

Vital pulp therapy in primary teeth

The primary aim of pulp therapy is to maintain the health of the tooth, the supporting structures, and to maintain the vitality of the pulp of the tooth that has been affected by decay, trauma, or any other causes. The primary objective of vital pulp therapy in primary teeth is the treatment of the reversible pulpal injury and maintenance of the pulp vitality/function. The aim is also to ensure that there is no evidence of postoperative signs or symptoms such as sensitivity, pain, or swelling. There should be no radiographic indication of pathologic external or internal root resorption or other pathologic changes. No harm should come to the succedaneous tooth [1].

Several factors come into play that affects the success of Vital Pulp therapy; these include an adequate blood supply, extent of inflammation and infection, obtaining homeostasis, disinfection of the site, properties, and biocompatibility of pulp capping materials and formation of a good coronal seal. The most important factor, however, is the vitality of the pulp and, in particular, the presence of adequate vascularization, which is essential for active function and formation of the odontoblasts [4].

Vital Pulp Therapy includes three therapeutic approaches:

- Indirect pulp capping (IPC) for teeth with cavities limited to the dentin and reversible pulpitis;
- Direct pulp capping (DPC) for healthy vital teeth with pinpoint mechanical or traumatic pulp exposure and
- Pulpotomy, which too is considered in cases with pinpoint pulp exposure in a vital tooth [1].

We will also be discussing protective liners that can be used to protect the pulp in teeth with healthy pulp after complete caries removal [4].

Protective liner

In primary teeth with a normal pulp, a protective liner may be placed in areas where the preparation extends deep, in close proximity to the pulp. A Liner is a liquid placed in a thin layer on the pulpal surface of a deep preparation to cover the exposed dentin tubules. It acts as a protective barrier between the pulp and the restorative material or cement. It minimizes injury to the pulp, promotes healing of the pulp tissue and minimizes postoperative sensitivity [4].

Indications

Protective Liners are used in teeth with healthy pulp after all caries have been removed, to protect the pulp in areas where the preparation extends deep.

Aim

The placement of liners in deep areas of the preparation is done to maintain the tooth’s vitality, facilitate pulp tissue healing, promote tertiary dentin formation, and minimize bacterial microleakage. There should be a reduction in the incidences of adverse post-treatment clinical signs or symptoms such as sensitivity, pain, or swelling [5].

Materials that are commonly used as liners include calcium hydroxide, dentin bonding agent, or glass ionomer cement.

Indirect pulp capping



Figure 1: Indirect Pulp Capping in a Primary Tooth with GIC [9].

Indirect pulp capping is a procedure done in teeth that have a deep carious lesion that is approximating the pulp, but there are no signs or symptoms of pulp degeneration. In IPC, the deepest layer of the carious dentine is not excavated and is left in place to avoid pulp exposure. It is instead, covered with a biocompatible material [1].

The rationale behind Indirect Pulp Capping is that after the cavity has been sealed properly, the few viable bacteria that remain in the deeper dentine layers get inactivated. Clinical studies that looked specifically at the partial caries removal and residual bacteria found that there was a dramatic reduction in the colony forming units (CFU) of bacteria after IPC treatment. This highlights the importance of cavity seal during these procedures. As long as the tooth remains sealed and there is no contamination from microbes, dental caries likely to arrest, and reparative dentin is likely to form as a shield of the pulp. Current literature suggests that if the tooth remains asymptomatic, it may not be necessary to reenter the tooth to remove residual caries [6]. The success rate of IPC has been reported to be higher than 90% in primary teeth. A greater success rate of IPC is seen than pulpotomy in long-term studies and allows for a normal exfoliation time. Therefore, it is preferable to a pulpotomy if the pulp is normal or has been diagnosed with reversible pulpitis [7].

Indications

Indirect pulp capping is indicated in a primary tooth, with no symptoms of pulpitis or with symptoms of reversible pulpitis, when removal of the deepest layer of the carious dentin may result in pulp exposure. Clinical and radiographic assessment of the vitality of the tooth is necessary prior to the procedure to ensure that the pulp has not been irreversibly damaged and that it will be able to heal from the carious insult [8].

Aim

The restorative material should completely seal the remnant carious dentin from the oral environment. The tooth should be able to maintain its vital status. There should be no evidence of postoperative signs or symptoms such as sensitivity, pain, or swelling. There should be no radiographic indication of pathologic external or internal root resorption or other pathologic changes. No harm should come to the succedaneous tooth [5].

Several medicaments have been tried for Indirect Pulp Capping, including Resin Modified Glass Ionomer Cement (RMGI), Calcium Hydroxide, Mineral trioxide aggregate (MTA), dentin bonding agents, zinc oxide/eugenol, and Medical Portland cement. Of these, RMGI appears to have the highest rate of success, especially when used with Chlorhexidine, followed by MTA and Calcium Hydroxide with almost similar rates of success. In a study where a dentin-bonding agent was used for pulp capping, it too showed a very good success rate [9,10].

Owing to the high solubility and low compressive strength of Calcium Hydroxide, in cases where Calcium hydroxide is used for indirect pulp capping, it is essential to place Glass Ionomer cement or reinforced Zinc oxide Eugenol over it in order to seal against microleakage. These materials provide an added benefit of inhibitory activity against cariogenic microbes. To seal the tooth from microleakage, the tooth then is restored with a material. Current literature suggests that if the tooth remains asymptomatic, it may not be necessary to reenter the tooth to remove residual caries [6].

Direct pulp capping



Figure 2: [A] Direct Pulp Capping with Calcium Hydroxide and RMGI base in primary molar after pin point exposure during caries excavation. [B] 24 month follow up [23].

Direct Pulp capping is done in cases of pinpoint exposure of the healthy pulp, either mechanically/accidentally, during cavity preparation or due to a traumatic injury. A biocompatible, radiopaque material is placed in contact with the exposed pulp, and the tooth is restored with a material that seals the cavity and prevents microleakage and bacterial contamination [1].

The treatment aims to stimulate the formation of tertiary dentin by the healthy pulp at the exposure site. Direct pulp capping of primary teeth is a very controversial procedure, and the guidelines published by the American Academy of Pediatric Dentistry (AAPD) do not recommend DPC for caries exposed to primary teeth [11]. However, recent clinical trials have shown promising results and may challenge this policy in the near future [12].

Indications

This procedure is indicated in a deciduous tooth in cases of pinpoint exposure of the healthy pulp, either mechanically/accidentally, during cavity preparation or due to a traumatic injury. However, case selection in these cases is crucial. The injured tooth must be clinically vital and asymptomatic, and the exposure site must be pinpoint in diameter. The bleeding at the exposure site must be controlled. Direct pulp capping of carious pulp exposure in a primary tooth is not recommended as the exposure site may be infected by bacteria from the lesion and may result in pulp inflammation, causing the failure of treatment [13].

Aim

The tooth should be able to maintain its vital status. There should be no evidence of postoperative signs or symptoms such as sensitivity, pain, or swelling. There should also be reparative dentin formation and pulpal healing. There should be no radiographic indication of pathologic external or internal root resorption or other pathologic changes. No harm should come to the succedaneous tooth [5].

A variety of medicaments have been introduced for Direct Pulp Capping, including Calcium Hydroxide, Zinc Oxide cement, Formocresol, polycarboxylate cement, dentin bonding agents, MTA, Enamel matrix derivatives, and calcium-enriched mixtures. MTA has shown the highest success rate among these, followed by Calcium Hydroxide [12].

Recently, lasers have been advocated for Direct Pulp Capping. The current clinical success rate for laser-assisted direct pulp capping is approximately 90%. It is contemplated that with the conjugated use of microscopes, there would be an increase in the long term success rates of DPCs owing to the improved working conditions and increased effectiveness of the interaction between laser-assisted pulp and capping material. This would also expand case selections/applications of Direct Pulp Capping [14].

Pulpotomy

The procedure of pulpotomy is done in a primary tooth with extensive caries that do not show any evidence of a radicular pathology when caries removal results in a carious or mechanical pulp exposure [1]. The coronal part of the pulp is amputated, and the remnant vital radicular pulp is treated with pharmacotherapeutic medicaments or non-pharmacotherapeutic treatments such as lasers or electro-surgery [15].

The rationale being this treatment is based on the healing capacity of the healthy radicular pulp tissues following the amputation of the infected or affected coronal pulp. A pulpotomy is the most common treatment for pulp exposure in symptom-free primary molars. Success rates decrease to about <70% after 36 or more months [1].



Figure 3: Pulpotomy of Primary Second Molar with MTA. (a) Preoperative clinical appearance of 2nd mandibular primary molar tooth, (b) preoperative radiological appearance of 2nd mandibular primary molar tooth, (c) providing hemostasis, (d) condensation of mineral trioxide aggregate, (e) restoration with SCC, (f) first radiograph after treatment [22].

Indications

The pulpotomy procedure is indicated in primary teeth with healthy pulp or reversible pulpitis when there is the exposure of the pulp during caries removal or due to a traumatic injury [16]. The coronal tissue is amputated, and the remaining radicular tissue has to access. It should be vital without any signs of suppuration, purulence, or necrosis. There should be no excessive, uncontrollable hemorrhage. There should be no radiographic indication of pathologic external or internal root resorption or other pathologic changes [5].

Aim

The primary aim of a pulpotomy is to maintain the vitality of the radicular pulp. It should remain asymptomatic without any clinical signs or symptoms such as pain, sensitivity, or edema. Postoperative radiographic evidence of pathologic external root resorption must not be present. Internal root resorption, if present, may be self-limiting and stable. If the Internal resorption causes perforation of the tooth and damage to supporting bone and structures or shows signs of infection, inflammation, the tooth should be removed. There should be no injury to the succedaneous tooth [17].

A variety of pharmacotherapeutic medicaments and non-pharmacotherapeutic treatments such as lasers or electrosurgery have been used for pulpotomies. Medicaments that have been used include Formocresol, Glutaraldehyde, Ferric Sulfate, MTA, Calcium Hydroxide, Sodium Hypochlorite, CEM cements, BMPs, to name a few [18]. Of these MTA appears to be the most successful compared to the previously popular Ferric sulfate and Formocresol and may now be the material of choice for pulpotomies. Clinical trials show that MTA works equal to or better than Formocresol or ferric sulfate. Calcium Hydroxide has shown less long term success [19].

Electrosurgery also has demonstrated results comparable to that of Formocresol and Ferric Sulfate. Lasers, too, have been used, but there are not enough studies in their favor yet to advocate for their regular use in pulpotomies [20].

After successful completion of the pulpotomy process, the pulp chamber is sealed from microleakage with a suitable base material such as zinc oxide eugenol. Stainless steel crowns have been found to be the most successful long-term restoration post pulpotomies. Amalgam restorations and composite restorations too can be used provided there's is enough tooth structure remaining, and the tooth has a life span on 2-3 years [21].

Discussion

We can conclude that Indirect Pulp Capping is a successful and favorable procedure for treating primary teeth with deep caries that have no exposure of pulp, provided the pulp is healthy or has reversible pulpitis. It is a low-cost procedure with good long-term success and is better at retaining the primary teeth until their natural exfoliation. IPC also has fewer side effects [12].

Direct Pulp capping is still a controversial technique for primary teeth. However, the introduction of new biomaterials has challenged this theory, but the long-term evaluation is still required [12].

A pulpotomy is the most common treatment for pulp exposure in symptom-free primary molars with a healthy pulp, but in most cases, the success of pulpotomy decreases over time from $\geq 90\%$ during the first 6-12 months to $\leq 70\%$ after 36 months or more [1].

A pulpotomy in primary molars have shown some side effects. Of these, Internal root resorption is the most unfavorable side effect. It can be due to chronic inflammation of the residual radicular pulp. Internal Root Resorption post Pulpotomy can be attributed to diagnostic errors made during the assessment of the pulp or due to technical failure during the procedure. Early exfoliation of teeth after pulpotomy is another common problem. A study found that more than 35% of Formocresol pulpotomies teeth exfoliated almost 6 months earlier than non-pulpotomies teeth [1]. Another complication is the formation of dentigerous cyst in the permanent successors of deciduous teeth, which had pulpotomy [24].

Conclusion

We can conclude that Indirect Pulp Capping is a successful and favorable procedure for treating primary teeth with deep caries that have no exposure of pulp, provided the pulp is healthy or has reversible pulpitis. It is a low-cost procedure with good long-term success and is better at retaining the primary teeth until their natural exfoliation. Direct Pulp capping is still a controversial technique for primary teeth. However, the introduction of new biomaterials has challenged this theory, but the long-term evaluation is still required. A pulpotomy is the most common treatment for pulp exposure in symptom-free primary molars with a healthy pulp and appears to have good success rates [1,7,12].

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