

## Diagnosis and Concepts of Vital Pulp Therapy in Primary Teeth

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### Abstract

The pulp is the most important vital tissue of a tooth. Maintaining the vitality of pulp is important to maintain the primary teeth in function till their exfoliation. However, often due to dental caries and trauma these teeth become non-vital and are lost prematurely. Hence the only way to save these teeth is by means of Vital Pulp Therapy (VPT). This treatment modality includes Indirect Pulp Capping (IPC), Direct Pulp Capping (DPC) and Pulpotomy. The success of these treatment methods depend on early diagnosis of pulp and periradicular tissue status, maintenance of vitality of pulp and vascularization of pulp.

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

### Introduction

Maintaining the health and integrity of the teeth and their supporting tissue is the primary goal of vital pulp therapy [1]. It is the treatment objective of vital pulp therapy to maintain the vitality of pulp affected by dental caries, trauma and other causes. Maintaining primary teeth in the dental arch till their exfoliation is important because premature loss of these teeth leads to malocclusion besides functional and esthetic problems. This can only be achieved through vital pulp therapy.

The indications, objectives, and type of pulpal therapy are dependent on the clinical conditions of the pulp whether pulp can be vital or non-vital; it can be reversible or irreversible or necrotic [2]. These clinical conditions are derived from medical history, past and present dental history including current symptoms and chief complaint, dental treatment history, subjective evaluation of the area associated with the present symptoms and chief complaint, objective extra oral and intra oral examination of the soft and hard tissues, radiographic examination of the involved tooth/teeth and clinical test such as palpation, percussion and mobility.

### Diagnosis [3]

In order to determine the most appropriate treatment it is important to provide a provisional diagnosis about the pulpal status of the tooth/teeth concerned.

### Signs and symptoms

The following signs and symptoms are indicative of pulpal inflammation and pathology:

1. Any history of spontaneous severe pain particularly at night.
2. Reported pain on biting.

3. Subsided pain with analgesics.
4. Clinical extent of carious lesion.
5. Presence of intra oral swelling or sinus.
6. History of intra oral or facial swelling.

### Special investigations

1. Gentle finger pressure to determine tenderness and mobility.
2. Electric pulp testing and thermal testing are not appropriate for primary teeth.
3. Radiographs are mandatory which can provide information about the depth and extent of the caries lesion, proximity of a restoration to pulp horns, presence of any apical/furcation radiolucency, degree of pathological or physiological root resorption, and presence of a successor.

### Indications for tooth retention

1. Medical history: Tooth retention is indicated in patients who have history of bleeding disorders and are at risk of bleeding on extraction. Patients who require general anesthesia for extraction are at risk due to cardiac problems, cystic fibrosis; are also indicative for tooth retention.
2. Dental history: Retention of tooth is indicated when the extent of carious lesion is minimal, hypodontia of permanent dentition and prevention of mesial migration of first permanent molars is desirable.

### Indications for tooth extraction

1. Patients who at risk of infection due to immunocompromised and susceptibility of infective endocarditis.
2. Poor prognosis even after pulp therapy.
3. Extensive internal root resorption.
4. Tooth with 2/3<sup>rd</sup> root resorption and about to exfoliate.
5. Extensive pathology with recurrent acute facial swelling.
6. Removal is desirable for Orthodontic treatment.
7. Parents with undesirable attitudes towards pulp therapy.

Teeth showing signs or symptoms such as history of spontaneous pain, presence of sinus tract, soft tissue inflammation without involvement of gingiva or periodontium, excessive mobility without trauma or exfoliation, furcation/apical radiolucency and extensive radiographic internal /external resorption have a clinical diagnosis of irreversible pulpitis or necrosis. These teeth require non-vital pulp therapy.

Teeth showing provoked pain of short duration on exposure to stimuli and relieved with analgesics, by brushing or upon removal of

stimuli and without signs or symptoms of irreversible pulpitis or necrosis are candidates for vital pulp therapy.

### Vital pulp therapy in primary teeth

Vital Pulp Therapy (VPT) is indicated in primary teeth with normal pulp or reversible pulpitis. This treatment modality includes the following treatment options:

1. Protective base or liner as pulp protection.
2. Indirect pulp capping.
3. Direct pulp capping.
4. Pulpotomy.

### Protective base or liner as pulp protection

The term pulp protection was coined by AAPD in 2014 which recommends the placement of a thin layer of base or liner on the axial and pulpal walls of cavity preparation to act as a protective barrier between the restorative material and the pulp. Materials that can be used as protective base or liner are a thin layer of calcium hydroxide, glass ionomer cement or dentin bonding agents.

**Indication:** In a tooth with a normal pulp when both infected and affected dentin is removed completely from the pulpal floor of the cavity prepared for restoration, a thin layer of protective material is placed to minimize pulpal injury, promote pulp tissue healing and to prevent post-operative sensitivity.

**Objective:** Placement of a protective base or liner in the deep cavity preparation is to promote pulp tissue healing thereby preserving tooth vitality, encourage tertiary dentin formation and prevention of microleakage to reduce post-operative pain or sensitivity.

### Indirect pulp capping

It is a treatment procedure in which a layer of biocompatible material is placed over the remaining carious dentin which is left behind to avoid pulp exposure if completely removed in a tooth with a deep carious lesion approximating the pulp but without any signs or symptoms of pulp degeneration.

### Rationale of indirect pulp capping

1. To arrest carious process and to provide conducive conditions for the formation of calcific dentine bridge or reactionary dentine.
2. To promote pulpal tissue healing and maintain the vitality of pulp tissue.

### Indications

1. Teeth with deep carious lesion without radiographic pulp exposure.
2. Teeth with no pulpitis or with reversible pulpitis.

**Objectives:** The radiopaque material should completely seal completely the involved dentin from the oral environment. The tooth vitality should be preserved. There should be no signs or symptoms of post-operative pain or sensitivity or swelling. Radiographically, there should be no evidence of pathologic external or internal root resorption. It should not cause any harm to the succedaneous tooth.

### Procedure

1. The tooth is anesthetized and isolated with a rubber dam.
2. All caries are removed at the dentine-enamel junction.
3. With great care the soft deep carious dentine over the pulp region is removed judiciously with a hand excavator or a slowly rotating large round steel bur without pulp exposure.
4. An appropriate lining material such as calcium hydroxide is placed.
5. A definitive restoration or a preformed crown is placed to provide external coronal seal.

Several biocompatible materials have been advocated for indirect pulp capping such as mineral trioxide aggregate (MTA), medical Portland cement (PC), calcium hydroxide (CH), resin modified glass ionomer (RMGI), dentin bonding agents and bioactive molecules such as enamel matrix protein (Emdogain) or members of bone morphogenic protein (BMP) super family such as tissue growth factor- $\alpha$  (TGF- $\alpha$ ) [4].

Since the tooth remains sealed from further bacterial contamination from the oral environment, the prognosis is good for caries to arrest and reparative dentin to form to protect the pulp. Indirect pulp capping has been shown to have a higher success rate than pulpotomy in long term studies. Success rate of indirect pulp capping have been reported to be higher than 90% in primary teeth.

### Direct pulp capping

It is a procedure which is carried out when there is mechanical/accidental exposure of pulp during cavity preparation in a healthy tooth. The pulpal exposure is pin point and free from oral contamination and the tooth is asymptomatic. A radiopaque biocompatible is placed over the exposure and the tooth is restored to prevent microleakage.

### Rationale of direct pulp capping

To promote dentine bridge formation at the site of pulpal exposure thereby maintaining the vitality of pulp tissue

### Indications

1. Pin point mechanical exposure surrounded by sound dentin.
2. Bleeding from the exposure site that can be controlled by a cotton pellet.
3. Traumatic exposure of pulp reported within 24 hours.

### Contraindications

1. Spontaneous pain.

2. Tooth mobility.
3. Thickening of periodontal membrane.
4. Intraradicular radiolucency.
5. Purulent or serous exudate.
6. Carious pulp exposure in a primary tooth.

### Objectives

1. The vitality of the tooth should be maintained.
2. There should be no evidence of post-operative signs or symptoms such as pain or sensitivity or swelling.
3. There should be healing of pulp tissue and formation of reparative dentine.
4. Radiographically no sign of pathologic external or internal root resorption or furcation/apical radiolucency should be evident.
5. It should not cause harm to succedaneous permanent tooth.

### Procedure

1. The tooth is anesthetized and isolated with a rubber dam.
2. A cotton pellet soaked with water or saline is placed with gentle pressure to stop pulpal hemorrhage.
3. A hard setting calcium hydroxide or mineral trioxide aggregate (MTA) is placed over the exposure.
4. An adhesive restoration or a preformed crown is placed to provide coronal seal.

The success rate of direct pulp capping in primary teeth is minimal but it may be high in immature young permanent teeth. The reason behind is that in primary teeth the undifferentiated mesenchymal cells which may differentiate into odontoclasts leading to internal resorption, are responsible for high failure rate of this treatment.

### Pulpotomy

It is performed in primary teeth with extensive caries without evidence of radicular pathology. It is the complete removal of the coronal portion of the dental pulp followed by placement of a suitable dressing or medicament that will promote healing and preserve vitality of the tooth (Finn, 1995).

### Objectives

1. The radicular pulp should remain healthy without any clinical signs or symptoms of post-operative pain or sensitivity or swelling.

2. No radiographic evidence of post-operative pathologic external root resorption should be there.
3. Internal root resorption may be self-limiting and clinicians should monitor it, removing the affected teeth if perforation causes loss of supporting tissue or shows clinical signs of inflammation and infection.
4. No harm to the succedaneous permanent tooth should be there.

### Rationale

1. Radicular pulp is healthy and capable of healing after complete removal of infected coronal pulp.
2. Preservation of the vitality of radicular pulp.
3. Maintains tooth in physiologic condition.

### Indications

1. Mechanical or traumatic pulp exposure with normal pulp or pulp with reversible pulpitis and healthy radicular pulp.
2. Pain if present is neither spontaneous nor persists after removal of stimuli.
3. Tooth is restorable and should possess at least 2/3<sup>rd</sup> of its root length.
4. Vital tooth with healthy periodontium.
5. Hemorrhage from the amputated site is pale red and is easy to control.
6. Primary tooth is preferable to a space maintainer in mixed dentition stage.

### Contraindications

1. Persistent pain.
2. Tenderness on percussion.
3. Tooth with resorption of more than 1/3<sup>rd</sup> of its root length.
4. Large carious tooth with non-restorable crown.
5. External or internal resorption.
6. Pathological tooth mobility.
7. Uncontrollable hemorrhage from canal orifice.
8. Medically compromised patients.
9. Swelling or presence of fistula.

10. Calcification of pulp.

### Types of pulpotomy

#### A. Vital Pulpotomy

##### 1. Devitalization

- i) Single sitting pulpotomy
  - a) Formocresol pulpotomy
  - b) Electrosurgery
  - c) Laser
- ii) Two stage pulpotomy
  - a) Gysi triopaste
  - b) Easlick's formaldehyde
  - c) Paraform devitalizing paste

##### 2. Preservation

- i) Glutaraldehyde
- ii) Ferric sulphate
- iii) MTA

##### 3. Regeneration

- i) Bone Morphogenetic Protein

#### B. Non-Vital Pulpotomy (Mortal pulpotomy)

- 1. Beechwood cresol
- 2. Formocresol.

### Procedure

- 1. The tooth is anesthetized and isolated with a rubber dam.
- 2. All the remaining dental caries is completely removed.
- 3. Using a non-end cutting bur the roof of the pulp chamber is completely removed.

4. The coronal pulp tissue is removed with a sterile sharp excavator or a large round bur in a slow speed handpiece.
5. A sterile cotton pellet soaked with saline or water is placed with gentle pressure to stop bleeding.
6. For direct application to the amputated radicular pulp stumps the following medicaments can be selected:
  - a. Application of 15.5% ferric sulphate solution on the pulp stumps with microbrush for 15 seconds to stop bleeding followed by thorough rinsing and drying.
  - b. Application of 20% (1:5 dilution) Buckley's formocresol with a cotton pellet for 5 minutes to achieved tissue fixation.
  - c. Application of MTA with an MTA carrier on to the radicular pulp.
  - d. A layer of pure calcium hydroxide powder is well condensed directly over the radicular pulp.
7. A layer of zinc oxide eugenol or glass ionomer cement is placed.
8. Finally, the coronal seal is provided with an adhesive restoration or a preformed crown.

### Conclusion

Indirect pulp capping is recommended in primary teeth with deep carious lesion without pulp exposure. It offers greater advantages because of its low cost and high success rate. Direct pulp capping in primary teeth is usually not encouraged because of lower success rate. But with the introduction of new materials it is now successful in primary teeth. Pulpotomy with MTA and biodentine proved very effective with high success rate. Hence it is also recommended that both clinical and radiographic diagnosis is necessary before deciding treatment plan for greater success.

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