Vital Pulp Therapy: Updated Protocol

Dr.Niladri Maiti,[1] Prof. Dr.Babacar Touré[2] , Prof. Dr. Rachida Amezian[3]
[1 ,2] Department d'Odontologie Conservatrice, Faculté Internationale de Médicin Dentaire , College of Health Sciences, UIR, Morocco.
[3]Dean, Faculté Internationale de Médicin Dentaire, College of Health Sciences, UIR,Morocco.
Corresponding Author Email**: niladri.maiti@uir.ac.ma**

Abstract

The aim of pulp protection is to maintain the integrity and health of the teeth and their supporting tissues. It is a treatment objective to maintain the vitality of the pulp of a tooth affected by caries, traumatic injury, or other causes. The sequence of protocol followed by the operator depends on lot of factors. Those factors can alter the treatment outcome.

Keywords: Vital Pulp Therapy, Pulp Capping, Pulpectomy

INTRODUCTION

According to The American Heritage Stedman's Medical Dictionary “The soft tissue forming the inner structure of a tooth and containing nerves and blood vessels called tooth PULP”.

The soft tissue within the pulp cavity, consisting of connective tissue with various kind of formative cells, resorptive cells, defense cells, blood vessels, nerves, and lymphatic, and at the periphery a layer of odontoblasts capable of internal deposition and repair of the dentin is called PULP. Pulp is a soft and gelatinous tissue as by weight or volume majority is water (75-80%). Pulp contains no inorganic component except in some cases where some calcified structure may present which called pulp stone which may be occur as physiological or process in response to irritants so pathological. Total no of pulp organ is 52 during human life among that 20 deciduous dentition and is 32 adult dentition. The pulp cavities of posterior teeth are larger than of anterior teeth which is approximately four times larger in size.

The pulp tissue has two main components: coronal pulp and radicular pulp.

Functions of Pulp- Although the primary function of tooth pulp is to keep the tooth alive and the formation of dentin, it has several other functions as well include formative , nutrition, sensory ,defensive and protective.

For the proper function of mastication presence of tooth in living condition is very important and maintaining pulp vitality is important for function of tooth.

Vital pulp therapy is the treatment by which we can maintains pulp tissue in a healthy and functional state.

Pulp vitality and function is important for both mature and immature teeth for it's survival. But in case of immature teeth root development is required (if possible) so preservation of pulp vitality is very important whenever possible. The main goal of vital pulp therapy is to preserve the vitality of pulp and eradicate inflammatory reactions if it is in reversible state, to allow pulp tissue healing and to protect the pulp tissue from exogenous stimuli like mechanical, Bacterial, Trauma, chemical agents, iatrogenic and thermal to any dangerous damage.

SOURCES OF PULPAL IRRITATION

a) Mechanical

b) Bacterial -

I. Caries
II. Accidental exposure
III. Fracture
IV. Percolation around a restoration
V. Extension of infection from gingival sulcus
VI. Periodontal pocket and abscess
VII. Anachoresis (Process by which microorganisms get carried by the bloodstream from another source localize on inflamed tissue)

c) Thermal

d) Trauma

e) Chemical

IMPORTANCE OF PULP PROTECTION

The primary objective of pulp protection is to maintain the integrity and health of the teeth and their supporting tissues. It is a treatment objective to maintain the vitality of the pulp of a tooth affected by caries, traumatic injury, or other causes. Especially in young permanent teeth with immature roots, the pulp is integral to continue apexogenesis. Long term retention of a permanent tooth requires a root with a favorable crown/root ratio and dentinal walls that are thick enough to with-stand normal function. Therefore, pulp preservation is a primary goal for treatment of the young permanent dentition. A tooth without a vital pulp, however, can remain clinically functional **[1].**

a. to the chemical components of restorative materials.

b. Thermal protection against temperature changes in the pulp.

c. Electrical Mechanical protection during restorative procedures.

d. Barrier protection against galvanic current.

e. Pulp medication to allow pulp recovery in case of deep defects.

f. Adequate seal at the restoration –tooth interface against bacterial ingress.

METHODS OF PULP PROTECTION

A variety of clinical procedures have been used traditionally in restorative dentistry, with a considerable degree of success, although somewhat empirical and not always directed to the initiation of particular tissue events. The improvement in knowledge of molecular and cellular processes in dentine and pulp allows a better understanding the traditional procedures on these tissues.

Indirect pulp capping: Definition: Indirect pulp capping is defined as the application of a medicament over a thin layer of remaining carious dentin, after deep excavation, with no exposure of the pulp.

Indications:

The decision to undertake the indirect pulp capping procedure should be based on the following findings:

1.History

a. Mild discomfort from chemical and thermal stimuli

b. Absence of spontaneous pain

2. Clinical examination

a. Large carious lesion

b. Absence of lymphadenopathy

c. Normal appearance of adjacent gingiva

d. Normal color of tooth

3. Radiographic examination

a. Large carious lesion in close proximity to the pulp

b. Normal lamina dura

c. Normal periodontal ligament space

d. No interradicular or periapical radiolucency

Contraindications. Findings that contraindicate this procedure are listed below:

1. History

a. Sharp, penetrating pain that persists after withdrawing stimulus.

b. Prolonged spontaneous pain, particularly at night.

2. Clinical examination

a. Excessive tooth mobility

b. Parulis in the gingiva approximating the roots of the tooth

c. Tooth discoloration

d. Non-responsiveness to pulp testing techniques

3. Radiographic examination

a. Large carious lesion with apparent pulp exposure

b. Interrupted or broken lamina dura

c. Widened periodontal ligament space

d. Radiolucency at the root apices or furcation areas.

Materials used in indirect pulp capping:

Calcium hydroxide has been a gold standard for pulp capping and is being used since its use was first described by Zander in 1939[**2**]. Commercial available as Liner, COLTENE (Fig 1).

Fig No.1

It allows the formation of a reparative dentin through cellular differentiation, extracellular matrix secretion, and subsequent mineralization.[3] Various disadvantages such as gradual disintegration and formation of tunnel defects in the newly formed dentin have been commonly witnessed with calcium hydroxide when followed up for longer times**.[4]**.Various newer materials for Indirect Pulp Capping

including mineral trioxide aggregate (MTA),Calcium phosphate cement and different bioceramic materials (Fig 2)

Fig No.2

The ultimate objective of this treatment is to maintain pulp vitality [5**]**, by arresting the carious process, promoting dentine sclerosis (reducing permeability), stimulating the formation of tertiary dentine, and remineralizing the carious dentine. Success rates of indirect pulp treatment have been reported to be higher than 90% in primary teeth [6**]**, and thus its use is recommended in patients where a preoperative diagnosis suggests no signs of pulp degeneration.

Direct pulp capping:

Definition: According to the recent AAE glossary definition, mechanical pulp exposure refers to an "accidental exposure of the pulp by hand- or engine-driven dental instruments in the absence of dental caries." (Fig 3)

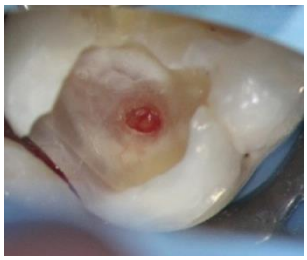

Fig No.3

The pulp of a tooth can be exposed due to several causes: caries, trauma or mechanical reasons, the latter typically due to a misadventure during tooth preparation. The direct pulp cap, in which a material is placed directly over the exposed pulp tissue, has been suggested as a way to promote pulp healing and generate reparative dentin. If successful, this procedure precludes the need for more invasive, more extensive and more expensive treatment. A number of factors have been shown to have an impact on direct pulp cap success. It is the purpose of this section to review these factors, with a particular emphasis on the materials that have been used, or suggested for use, in direct pulp capping.

Some studies have shown that a tooth is more likely to survive direct pulp capping if the initial exposure is due to mechanical reasons rather than caries. Caries penetration to the pulp will result in bacterial invasion of the pulp, resulting in pulpal inflammation. This leaves the pulp less able to respond and heal, compared to a mechanical exposure in which preexisting inflammation is not present. A logical extension of this is that teeth that are asymptomatic and exhibit no clinical or radiologic signs of pathology at the time of pulp capping tend to fare better than those teeth with such factors present. The placement of a permanent, well-sealed restoration at the time of pulp capping is crucial to clinical success.

Indications: Tooth selection for direct pulp capping involves the same vital pulp therapy like, to rule out signs of irreversible pulp inflammation and degeneration. The classic indication for direct pulp capping has been for ―pinpoint mechanical exposures that are surrounded with sound dentin. The exposed pulp tissue should be bright red in color and have a slight hemorrhage that is easily controlled with dry cotton pellets applied with minimal pressure. Frigoletto noted that small exposures and a good blood supply have the best healing potential. Although imprecise, the term ―pinpoint conveys the concept of smallness to the exposed tissue, which should have the lowest possibility of bacterial access. An empirical guideline has been to limit the technique to exposure diameters of less than 1 mm. Stanley has determined, however, that the size of the exposure is less significant than the quality of the capping technique in avoiding contamination and mechanical trauma to the exposure site and careful application of the medicament to hemostatically controlled pulp tissue. Equally important is the quality of the temporary or permanent restoration to exclude microleakage.

Contraindications: Contraindications to direct pulp-capping therapy include a history of

(1) spontaneous and nocturnal toothaches,

(2) excessive tooth mobility,

(3) thickening of the periodontal ligament,

(4) radiographic evidence of furcal or peri-radicular degeneration,

(5) uncontrollable hemorrhage at the time of exposure, and

(6) purulent or serous exudate from the exposure.

Objectives: The tooth's vitality should be maintained. Pulp healing and reparative dentin formation should occur. There should be no radiographic evidence of internal or external root resorption, periapical radiolucency, abnormal calcification, or other pathologic changes. Teeth with immature roots should show continued root development and apexogenesis.

Direct Pulp Capping Materials: Zinc Oxide Eugenol (ZOE), Calcium Hydroxide, Glass Ionomer (GI)/Resin-Modifed Glass Ionomer (RMGI), Adhesive Systems, Mineral Trioxide Aggregate (MTA),

Pulpotomy:

Pulp amputation, or pulpotomy, is defined as a procedure in which part of an exposed vital pulp is removed, usually as a means of preserving the vitality and function of the remaining part [7**]**

The rationale of pulpotomy is

To remove the portion of the pulp tissue that has undergone irreversible changes and to leave behind healthy and vital tissue . Pulpotomy is essentially indicated as a treatment of normal pulp or reversible pulpitis associated with a carious lesion or after traumatic pulp exposure in primary teeth and immature permanent teeth [8-13]. In mature permanent teeth, full pulpotomy is actually only indicated as an emergency (routine) procedure before root canal treatment (RCT). During the last decade, in relation with a better understanding of pulp biology and the development of bioactive materials, pulpotomy has been reinvestigated as a definitive treatment of mature permanent teeth. The advantages of maintaining pulp vitality are numerous; this strategy seeks to keep all the functions of pulp, especially the vascularization, innervation, immunocompetency, neurosensory, and proprioceptive functions of the tooth. The dentin-pulp complex would also continue to protect itself by stimulating the formation of tertiary dentin or a mineralized barrier against aggressions[14-15]. Moreover, pulpotomy is technically less complicated, less time-consuming, and less expensive than RCT and could be indicated in difficult endodontic cases.

Indications for pulpotomy

1. Tooth has no history of spontaneous pain.

2. Tooth has acute minor pain that subsides with analgesics.

3. Tooth has no discomfort to percussion, no vestibular swelling and no mobility.

4. Radiographic examination shows normal appearance of periodontal attachment.

5. Pulp is exposed during caries removal or subsequent to recent trauma.

6. Tissue appears vital.

7. Bleeding from the pulp excision site stops with isotonic saline irrigation within 2 minutes.

Contraindications for Pulpotomy

1. A history of spontaneous toothache (not caused by papillitis resulting from food impaction)

2. A nonrestorable tooth where postpulpotomy coronal seal would be inadequate

3. A tooth near to exfoliation or if no bone overlies the crown of the permanent successor tooth

4. Evidence of periapical or furcal pathosis

5. Evidence of pathologic root resorption

6. A pulp that does not bleed (necrotic)

7. Inability to control radicular pulp hemorrhage following a coronal pulp amputation

8. A pulp with serous or purulent drainage

9. Presence of a sinus tract

Methods of pulpotomy:

Pulp curettage/Partial Pulpotomy

Cvek Pulpotomy

Complete Pulpotomy

Materials used in pulpotomy

Various pulpotomy agents, formaldehyde-based materials, electro surgery, lasers, glutaraldehyde, haemostatic medicaments, zinc oxide eugenol, bone morphogenic protein (BMP), collagen and calcium involving, dentin bridge inducing materials, have been recommended from the past to the present. The first pulpotomy agent used for primary teeth, introduced by Sweet, was formocresol (FC), which fixes and mummifies the tissue completely. However, the ideal pulpotomy treatment should leave the radicular pulp vital and healthy and completely enclosed within an odontoblast-lined dentin chamber; calcium hydroxide (CH) was the first medication that induced dentin bridge formation in pulpotomies. Another alternative pulpotomy agent, ferric sulpfte (FS), a haemostatic medicament, has been used because it might minimize the chances for inflammation and thereby prevent internal resorption (IR). In 1995, Torabinejad et al. described mineral trioxide aggregate (MTA) a biocompatible, dentin bridge inducing material and was used as a pulpotomy agent.

Recent advancement in vital pulp therapy method

1) Biodentin

2) Endo Sequence Root Repair Material (Bioceramic)

3) An MTA-derived pozzolan

4) Lasers : Both Diode laser and Erbium lasers are used as an adjunct in Endodontic therapy.

5) Calcium Phosphate Cement (Cpc)

6) Hydroxyapatite (HA)

7) TheraCal LC

8) CEM Cement

9) Novel Endodontic Cement (NEC)

10) Bioactive Glass (BAG)

11) Bone sialoprotein (BSP)-

12) Growth Factors-

13) Emdogain (Emd)-

14) Odontogenic Ameloblast Associated Protein (ODAM)

15) Enzymes –

16) MMB-TBB resin cement

17) MTYA1-Ca-

18) Stem Cells –

19) Bonding agents:

20) Resin Coating Technique in pulp protection:

21) Lyophilized freeze dried platelet

22) Ankaferd Blood Stopper (ABS)

23) Platelet Rich Plasma(PRP): PRP is generally synthesized from the own blood of the patient and centrifuging in a vortex.Followed by application of the synthesized material in the excavated site.

24) Pulpotec

25) Nigella Sativa oil (NS)

26) Castor Oil Bean (COB)

27) Propolis

Conclusion:

Many operative procedures can be traumatic to the pulp and the effects are at least somewhat cumulative. The dental practitioner should be fully aware of the methods and materials that can jeopardise the pulp. Knowledge of proper cavity preparation and its application can greatly reduce pulpal injury. Many materials including cavity varnishes, liners and bases are widely available on the market to reduce the occurrence of pulpal damage. However other important factors that can determine a good pulpal prognosis are patient factors, which include age, previous treatment history, dental characteristics and diet.

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