Clinical, Radiographic and Patient Acceptance Evaluation of LASER Compared to Formocresol Pulpotomies in Primary Molars

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List of Abbreviations:

- **AAPD**: American Academy Pediatric Dentistry.
- **CO_2** : Carbon dioxide.
- **Cw-mode**: continuous mode
- **Er: Cr,YSGG** : Erbium, Chromium:Yattrium-Scandium-Gallium-Garnet
- *Er:YAG:* Erbium:Yttrium-Aluminum-Garnet
- **FC**: formocresol
- **GIC**: Glass-ionomer cement
- **LLLT**: Low Level Laser Therapy
- **MTA**: Mineral Trioxide Aggregate
- **Nd:YAG**: Neodymium-yttrium-aluminum-garnet.
- **RCT**: Root canal treatment
- **Sec**: Second
- **VAS**: Visual analogue scale
- **WBFPRS** : Wong-Baker Faces Pain Rating Scale
- **WHO**: World Health Organization
- **ZnO/Eug**: Zinc Oxide/ Eugenol

Introduction

Maintaining the integrity and health of the oral tissues is the primary objective of pulp treatment. Pulpotomy has become the dominating pulp therapy for the primary dentition, because of the complicated anatomy of the root canals in primary teeth, the proximity of the permanent tooth germ and the difficulties in finding a root-canal filling material compatible with physiological root resorption. [(1)]

Pulp tissue is a highly specialized connective tissue necessary for the immune competence and sensation within a tooth, long after dentinogenesis is completed. The tissue, located in a specific rigid environment, has a complex blood flow and is rich in cellular and neural elements. It is very difficult for clinicians to diagnose the level of pulpal inflammation. [(2)]

When the carious process exposes the pulp, it reacts via inflammation limited to the area close to the carious lesion. If the pulp in the root canal seems to be unaffected, pulpotomy is the treatment of choice. [(3)]

Various techniques and materials have been recommended for these purposes, such as formocresol, glutaraldehyde, ferric sulphate, calcium hydroxide, Mineral Trioxide Aggregate (MTA), and LASER therapy, but a consensus on the ideal pulpotomy technique has not yet been reached. [(4)]

Formocresol (FC) has been considered as the most popular pulpotomy medicament for more than 60 years and the most universally taught and used medicament for primary teeth. However, its toxicity and carcinogenic potential has raised concerns. [(5)]

Such concerns have prompted researchers to investigate alternative pulpotomy materials and techniques with better clinical efficacy and without

secondary effects. However, still the question arises for safety and effectiveness of these medicaments. [6]

Recently, LASER technology has got more and more important role in modern dentistry. The use of LASER for pulpotomy has many advantages such as control of haemorrhage, sterilization of pulp tissues, stimulation of dental pulp cells causing increased healing, dentinogenesis and preservation of vitality of the dental pulp. It has been therefore proposed as an alternative for pulpotomy of primary teeth. [7]

However, the use of different types of LASERs and different settings caused confusion about the success rates of LASER pulpotomy, hence there is still no evidence about the use LASERs as an alternative to formocresol in pulpotomy of primary molars. [4]

Review of literature

Pulpotomy can be defined as' the amputation of the affected and infected coronal portion of the dental pulp, preserving the vitality and function of all or part of the remaining radicular pulp" [(8)]. Pulpotomy is one of the frequently used treatment in primary dentition and has been the treatment of choice for cariously exposed pulps in vital primary teeth [(9)].

Various pulpotomy modalities have been recommended for primary teeth. They can be classified into two categories: conservative (those that aim to maintain pulp vitality) and radical (consisting of pulpectomy and root filling). Although the coronal pulp is removed in the pulpotomy procedure, this treatment is considered in the conservative category, as it aims to leave the radicular pulp vital [(8, 10)]. It is based on the rationale that the radicular pulp tissue may be healthy or capable of healing after surgical amputation of the affected or infected coronal pulp [(11)]. It is a conservative therapy performed to remove the inflamed coronal pulp tissues followed by application of an effective and compatible bactericidal medicament which encourages the tissue in the root canals to remain vital. The aim of this treatment is to preserve the radicular pulp, avoiding pain and swelling, and ultimately to retain the tooth and thus preserve arch integrity. The desired end result is the timely exfoliation of the treated tooth and its replacement by a permanent successor [(9, 12)].

The pulpotomy procedure is indicated when caries removal results in pulp exposure in a primary tooth with a normal pulp or reversible pulpitis. The coronal tissue is amputated, and the remaining radicular tissue is judged to be vital without suppuration, purulence, necrosis, or excessive hemorrhage that cannot be controlled by a damp cotton pellet after several minutes, and there are no radiographic signs of infection or pathologic resorption [(13)].

It is difficult if not impossible to clinically determine the histological status of the pulp. Thus, the most important and also the most difficult aspect of pulp therapy is determining the health of the pulp or its stage of inflammation, so that an appropriate decision can be made regarding the best form of treatment.

A thorough clinical and radiographic assessment plays a key role in deciding whether the tooth pulp is likely to be treatable. Selection of the appropriate treatment for a tooth is essential to its long-term prognosis. To make the most accurate diagnosis, information must be obtained from several sources including a careful medical history, notation of the characteristics of pain, and thorough clinical and radiographic examinations [(14)].

The history and characteristics of pain are important factors in determining whether the pulp is in a treatable condition [(15)]. Provoked pain- stimulated by thermal, chemical, or mechanical irritants, and is reduced or eliminated when the noxious stimulus- indicates dentin sensitivity due to a deep carious lesion or a faulty restoration. The pulp is in a transitional state in most cases, and the condition is usually reversible. A final diagnosis can only be made based on clinical examination in conjunction with radiographic assessment [(15, 16)].
A careful extraoral and intraoral examination is of great importance in detecting the presence of a pulpally involved tooth. Only teeth with reversible pulpitis are indicated for vital pulpotomy. Several signs, such as redness and swelling of the vestibulum, or grossly decayed teeth with draining sinus tracts, are definitely indicative of irreversible pulpitis or pulp necrosis. Palpation, assessment of tooth mobility, and sensitivity to percussion are helpful diagnostic procedures. Fluctuation, felt by palpating a swollen mucobuccal fold, may be the expression of an acute dentoalveolar abscess prior to exteriorization [(15)].

Following clinical examination, a thorough radiographic examination using a high-quality bitewing or periapical radiographs must be obtained. Radiographs are valuable as aids in visualizing the presence or absence of the following: (i) deep caries with possible or definite pulp involvement; (ii) successful or failing pulpotomy or pulpectomy; (iii) pulpal changes such as pulp calcifications (denticles) and pulp obliteration; (iv) pathologic root resorption, which may be internal (within the root canal) or external (affecting the root or the surrounding bone) [(9)].

Internal resorption indicates inflammation of a vital pulp whereas external resorption demonstrates a non-vital pulp with extensive inflammation, including resorption of the adjacent bone; or periapical and interradicular radiolucencies of bone. In primary teeth, any radiolucency associated with a non-vital tooth is usually located in the furcation area, not at the apices. This is because of the presence of accessory canals in the pulpal floor area[(15)] .

There are instances when a final diagnosis can only be achieved by direct evaluation of the pulp tissue and a decision about treatment is made accordingly. Vital pulpotomy is only planned if the nature of the bleeding from the amputation site is normal (red color and hemostasis evident in less than 5 minutes with mild cotton pellet pressure). If bleeding persists, a more radical treatment should be undertaken (pulpectomy or extraction). Excessive bleeding is an indication that the inflammation has reached the radicular pulp [(8)].

Success or failure of pulpotomy is dependent on various factors such as an accurate diagnosis, the extent of pulpal inflammation, pulpotomy agent used, technique of using that agent, healing reaction of individual pulp, lining material used, adequate coronal seal, period of observation and the criteria used to determine the success or failure of the procedure [(18)] .

The ideal requisites of any pulpotomy material should be bactericidal, harmless to pulp and surrounding structures, promote healing of remaining radicular pulp without interfering with the physiologic root resorption and not possess any toxicity [19].

Choice of final restoration of the pulpotomized tooth depends on the amount of tooth structure that has been compromised by the caries process. For teeth with only occlusal involvement, a composite restoration is acceptable; however, if a proximal surface is involved, full coverage in the form of a stainless steel crown or esthetic full-coverage crown is required to ensure the requisite biological seal [5].

Pulp therapy requires periodic clinical and radiographic assessment of the treated tooth and the supporting structures. Post-operative clinical assessment generally should be performed every six months and could occur as part of a patient's periodic comprehensive oral examinations. The radicular pulp should remain asymptomatic without adverse clinical signs or symptoms such as sensitivity, pain, or swelling. There should be no postoperative radiographic evidence of pathologic external root resorption. Internal root resorption may be self-limiting and stable [13].

In search of an ideal pulpotomy medicament, various materials and techniques have been explored. According to Ranly, pulpotomy for primary teeth has been developed on three lines: devitalization (mummification, cauterization), preservation (minimal devitalization, noninductive), regeneration (inductive, reparative). The most commonly used approach in pediatric pulp therapy is the devitalization approach of formocresol pulpotomy [20].

Formocresol: