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Unveiling the Frozen Pulpotomy

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KEYWORDS
hemostasis, cryotherapy, pulpotomy

ABSTRACT:

Objective: To evaluate clinical and radiographic success of primary molar pulpotomies which used ice as hemostatic agent. **Methods:** In 10 healthy children,10 primary molars were selected for the study group. Hemostasis was achieved with ice and then covered with bio-ceramic material. time required to achieve hemostasis was noted. All teeth were restored with stainless steel crown. Follow up was done at 2 weeks, 1 month, 3 months. **Results:** Two tooth showed pain and periapical pathosis which lead to clinical and radiographic failure at 2 weeks. **Conclusion:** Cryotherapy can be preferred as hemostatic agent to achieve hemostasis in primary tooth pulpotomy.

Introduction:

One of the main goal of paediatric dentistry is to maintain the primary teeth till exfoliation, thus preserving the integrity of the arches.[1]

The goal of vital pulp therapy is to address potentially reversible damage to the pulp caused by caries, preserving the vitality and functionality of the pulp. Pulpotomy remains the most common treatment for pulp cavities exposed by caries in symptom-free primary molars.[2] traditional pulpotomy involves complete surgical removal of the coronal vital pulp tissue followed by placement of a biologically acceptable material in the pulp chamber and restoration of the tooth.[3]Time elapsed for achieving hemostasis is a parameter of clinical importance as it helps us to assess the status of pulpal damage and also to decide the outcome of treatment.[4]

There are different methods to achieve haemostasis but Saline-soaked cotton pellet method still serves as gold standard. Ferric sulfate (FeSO4) (FS) is another hemostatic agent that has gained popularity but not used widely as studies had suggested considerable internal resorption. Another promising alternative to hemostatic agents is sodium hypochlorite (NaOCl) having antibacterial properties as well but is chemical in nature.[4]In quest of newer more physiologic alternative to achieve hemostasis, we went back to age old concept of using ice and applied it in our dentistry.

Cryotherapy, derived from the Greek word "kryos," meaning "cold," refers to the therapeutic use of ice.[5] Vital pulp cryotherapy involves applying sterile water ice shavings to exposed pulp tissue to achieve hemostasis.[6]

This study aimed to evaluate the effects of cryotherapy on duration to achieve to haemostasis, clinical and radiographic success of primary tooth pulpotomies

Materials and Methods

This study was carried out in the Department of Paediatric and Preventive Dentistry, Daswani Dental College and Research Centre, Kota. Ethical clearance

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was been obtained. Ten cooperative children were selected for study who had given their written consent.

Inclusion Criteria

- Children of age 5-9 years
- Carious exposure to vital pulp
- Teeth which can be restored
- Children free from systemic diseases

Exclusion criteria

- History of swelling/sinus tract
- History of spontaneous pain and/or night pain.
- Haemostasis not achieved within five minutes
- Mobility
- Tenderness to percussion or palpation.
- History of allergy to anesthesia or to latex.
- Physiological resorption of more than one-third of the root

Procedure:

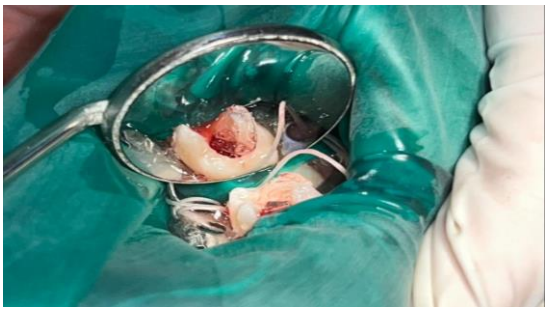
Once a decision was made, based on clinical and radiographic evaluation, to perform pulpotomy in a particular tooth, a prior written informed consent was obtained from the parent/guardian before initiating the procedure. After the informed consent is obtained, local anesthesia was administered prior to isolation with Rubber dam.

Excavation of dental caries was initiated with a large, slow-speed, round bur after determining the extent of the lesion before pulpal exposure. Deroofing of the pulp chamber was done with either a large, low-speed, round bur. After the deroofing was complete, the coronal pulp was amputated.

Shaved sterile-water ice (0° Celsius) was prepared and placed over the direct or indirect exposure of the pulpal tissue, along with the entire tooth. After approximately 60 seconds, the ice melted and was removed with high-speed suction. Time required to achieve haemostasis was noted. following removal of the melted sterile ice, the exposed or indirect exposed pulp was irrigated with 17% EDTA solution for 60 seconds

After the exposed or indirect exposed pulp had been treated with shaved sterile ice and EDTA, it was covered with a bio-ceramic material. Tooth was restored with Glass Ionomer Cement over which stainless steel crown was placed.

Shaved sterile-water ice (0° C) prepared with an ice shaving device.



Placement of shaved sterile water ice Irrigation with 17% EDTA

Placement of bio-ceramic material

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FOLLOW UP –

The evaluations comprised clinical and radiographic examinations.

The teeth were examined clinically at two weeks, one month, three months.

the following signs and symptoms, any of which were regarded as failure:

- history of spontaneous pain,
- a reliable reporting of tenderness to percussion/palpation,
- mobility,
- swelling, and
- fistula.

Treatment was recorded as a clinical success if any of these failure parameters were not met.

The evaluation of the radiographs, taken at two weeks, one month, three months, was made using a standard viewing box. Radiographic success was considered as absence of

- periapical/interradicular radiolucency,
- widened periodontal ligament space,
- loss of lamina dura, and
- internal/external root resorption.

Results –

CASES	TIME (min)	CLINICAL CRITERIA		RADIOGRAPHIC CRITERIA	
		SUCCESS	FAILURE	SUCCESS	FAILURE
1	1.95		✓		✓
2	1	✓		✓	
3	2	✓		✓	
4	1.5	✓		✓	
5	1.35		✓		✓
6	1.1	✓		✓	
7	1.2	✓		✓	
8	1.14	✓		✓	
9	1.11	✓		✓	
10	1.23	✓		✓	
Mean-	1.35	✓		✓	

Mean duration of haemostasis achieved is one minute thirty-five seconds.

All ten primary teeth were treated with pulpotomy

Eight teeth were successful on the basis of clinical and radiographic success criteria. Two teeth were failed clinically and radiographically at two weeks as they showed pain and periapical pathosis.

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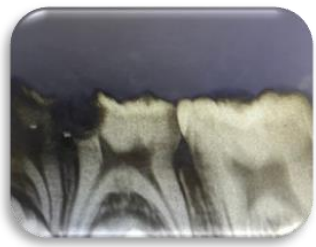
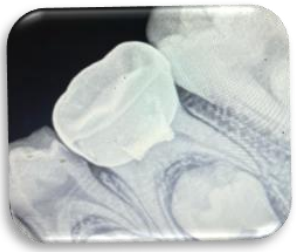


Pre-operative radiograph

Two week follow up



One month follow up

Three month follow up

Discussion -

Effective hemorrhage control following coronal pulp amputation is essential for the success of pulpotomy treatment. Prolonged bleeding may indicate pulpal inflammation, potentially compromising the pulp's ability to heal optimally. Therefore, managing hemorrhage promptly is crucial to support successful pulpotomy outcomes and promote pulp healing.[4]

The gold standard for achieving hemostasis is using a saline-soaked cotton pellet. In this technique, a moist cotton pellet is commonly placed over the pulp stumps following the removal of coronal pulp tissue. The moisture aids in controlling bleeding and promoting effective hemostasis. The pressure exerted by the cotton pellet is instrumental in halting the bleeding. Moreover, the cotton pellet can absorb excess blood, creating a clear field for the placement of additional materials such as medicaments or restorative materials. However, it's important to note that the time required to achieve hemostasis may be slightly longer.

Another we have for haemostasis is ferric sulphate,but it itself comes with several disadvantages like internal resorption, increased post operative pain and inflammation. Burnett and Walker[7] found a 50% failure rate for Ferric sulphate and Casas[8] et al also observed internal resorption in 55% of Ferric sulphate treated teeth.

In contrast, our study explores a novel approach using shaved sterile water ice, which achieved hemostasis with an average duration of 1.35 minutes. This method has been supported by research conducted by James Bahcall et al[5], where hemostasis was achieved with shaved sterile water ice in just 60 seconds.

According to Van't Hoff's law, cryotherapy cools tissues, causing blood vessels to constrict and slowing cellular metabolism. This reduces swelling, tissue damage, and free radical production, ultimately lowering oxygen demand and protecting cells from injury.[9,10]

Vasoconstriction reduces edema, while pain relief occurs due to nerve endings being blocked by the cold application. [11] The intensity of Vasoconstriction effect peaks at 15°C. Lowering body temperature also decreases peripheral nerve conduction. Specifically, myelinated A-δ fibers are completely deactivated at around 7°C, and nonmyelinated C-fibers at about 3°C, as demonstrated by Franz and Iggo [12] Changes in tissue pressure activate pain receptors known as thermoreceptors, which are sensitive to temperature. Cryotherapy stimulates these thermoreceptors, blocking pain signals (nociception) within the spinal cord.[9]. Nociceptors, specialized nerve endings activated by

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tissue injury, play a key role in pain sensation. Thus, Cryotherapy's analgesic effect primarily arises from two factors: reduced release of inflammatory chemical mediators of pain and slower conduction of neural pain signals.

In various studies, cryogenic fluid has been experimentally tested against the gold standard irrigant, sodium hypochlorite. It has demonstrated greater efficacy in antibacterial action by reaching the desired depth and causing immediate freezing and subsequent destruction of bacterial cells.[13]

Another aspect that enhances the physiological nature of the procedure is the application of 17% EDTA for 60 seconds following the achievement of hemostasis. This step has been shown to release bioactive growth factors from the dentin, thereby improving the success rate of the procedure. Additionally, dentin conditioning with EDTA promotes the migration, adhesion, and differentiation of dental pulp stem cells, further contributing to the procedure's success.[5]

Although,it has been stated in literature that sodium hypochlorite should be used as irrigant to achieve haemostasis but it has shown to damage the pulpal stem cells and thus decreasing growth factors from dentin.[14] This underscores the importance of considering alternative approaches.

It's worth noting that EDTA is an anticoagulant and, as a chelating agent, it can remove calcium, which is crucial for blood clotting. However, in the context of its use in vital pulp cryotherapy, researchers have observed that when EDTA is used after cryotherapy, there seems to be no anticoagulant effect. It is speculated that the hemostatic effect of cryotherapy may counteract the chelating effect of EDTA on calcium, thus preserving the blood clotting process.[5]

Preformed metal crowns stand out as the preferred choice or the benchmark in restorative dentistry due to their exceptional ability to safeguard teeth from fractures through comprehensive crown coverage. They excel in minimizing the risk of leakage, thereby ensuring a reliable biological seal that promotes optimal oral health.[15]

In our study two cases failed radiographically at two weeks, furcation radiolucency was seen. Clinically cases reported pain and tenderness on percussion.

The limitation of the study is that it has been carried out on very small sample. Further research on this topic is needed and should be carried out on large sample.

Conclusion –

Cryotherapy offers an alternative method for achieving hemostasis in vital pulp therapy. By applying sterile water ice shavings to the exposed pulp tissue, cryotherapy can effectively control bleeding. This technique provides a non-invasive and physiological approach of achieving hemostasis, making it a viable option in vital pulp therapy procedures.

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Journal of Chemical Health Risks

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