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Review Article

Comparison of various pulpotomy techniques: coronal, cervical, and full pulpotomy

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ABSTRACT

The preservation of deciduous teeth is crucial in pediatric dentistry to maintain normal speech, development, and self-esteem, while also preventing secondary issues like space loss and tooth impaction. Different materials and approaches have been explored over time, ranging from mummification to maintaining pulp vitality and promoting healing. In today's conservative dentistry, techniques like indirect pulp treatment and partial pulpotomy (PP) have gained popularity. Adults diagnosed with irreversible pulpitis due to deep caries often receive root canal therapy (RCT). However, coronal pulpotomy treatment (CPT) has emerged as an affordable alternative for those unable to afford RCT. CPT removes the coronal pulp, allowing the remaining pulp to remain vital. PP and complete pulpotomy are explored as treatments for teeth with signs of irreversible pulpitis. Success depends on eliminating infected tissue, using aseptic techniques, and achieving a tight restorative seal. Materials like MTA have shown favorable outcomes. Direct pulp therapy and PP can effectively preserve vital pulp in primary and young permanent teeth. The choice of pulpotomy material, such as MTA, plays a significant role in success rates.

Keywords: Pulpotomy techniques, Primary teeth preservation, Conservative dentistry, Indirect pulp treatment, Coronal pulpotomy

INTRODUCTION

The conservation of primary teeth in form and function until their normal exfoliation is one of the fundamental objectives of pediatric dentistry. Not only is it critical for healthy speech, development, and self-esteem, but it also serves as the best safeguard against secondary problems, including space loss and long-term tooth impaction.[1] Pulpotomy is one such procedure that focuses on the preservation of pulp and its functions like proprioception, innervation and vascularisation.[2] In asymptomatic primary teeth with deep carious lesions approximating the pulp, the coronal pulpotomy is one of the most common ways of achieving the goal of tooth preservation. The main goal of the pulpotomy treatment is to remove the affected coronal pulp tissue so that the unaffected radicular pulp tissue can continue to function normally until the tooth is ready to exfoliate naturally.[1] In the past, medications were first used to try to keep the damaged primary tooth in place with the intention of mummifying the residual pulp. New products have been evaluated over time and with ongoing studies, both in vitro and in vivo, with results that are different from mummification. These new approaches have made it possible to categorise

pulpotomy procedures in accordance with the purpose of treating patients with these various materials.[1] In today's world of conservative dentistry, clinicians focus on techniques that do not invade the pulp space or minimally invade the space and have the objective of maintaining pulp vitality in its entirety allowing the tooth to heal. Such are indirect pulp treatment (IPT), and those techniques that only partially remove the affected tissue like PP.[1] Conventional dentistry adheres to the ideas of G. V. Black about extension for prevention and total caries extraction in deep carious lesions or lesions that approach the pulp. Black stated that the deeper portion should be freed of any remaining softened material with spoon excavators. In no case should any decayed and softened material be left. It is better to expose the pulp of the tooth than to leave it covered only with softened dentin.[3] In the latter part of the twentieth century, conservative or minimally invasive dentistry (MID) has revolutionized the approach to caries excavation and diagnosis both in deciduous and permanent teeth.[4] Leaving affected dentin is acceptable, and where a pulpotomy was most commonly end result of deep caries in a primary molar or incisor because "pink" could be seen, presently several options to preserve tooth vitality and integrity are available. Therefore, this review will list and discuss the pulpotomy techniques including coronal, cervical, and full pulpotomy.

LITERATURE SEARCH

This study is based on a comprehensive literature search conducted on 9 June, 2023 in the Medline, PubMed and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed various pulpotomy techniques: coronal, cervical, and full pulpotomy. There were no restrictions on date, language, participant age, or type of publication.

DISCUSSION

When adults are diagnosed with symptomatic or asymptomatic irreversible pulpitis secondary to deep carious pulp involvement, most are treated with RCT.[5] For patients who cannot afford RCT, tooth extraction has been the only option until recently when CPT has become available. This treatment removes the entire coronal pulp and keeps the remaining pulp vital in the canals. CPT has been considered a definitive treatment for primary teeth, young immature permanent teeth, and traumatic pulp exposure in mature teeth.[5] The carefully exposed vital pulp can repair and heal, remaining vital even after inflamed pulp tissue is removed. CPT could be performed in mature teeth with closed root apices by a general dental practitioner and may prove especially useful for posterior permanent teeth. Its use would increase patients access to affordable dental care.

Complete and PP are now being explored as possible treatment modalities in teeth with signs indicative of symptomatic irreversible pulpitis (SIP).[6,7] Whilst both have shown successful outcomes, the benefits and drawbacks of the individual techniques create confusion in the clinician's mind whilst choosing one over the other. Ricucci et al concluded that the elimination of the infected tissue from the pulp under strict aseptic techniques, followed by bacteria-tight restorative seal can help achieve adequate success.[8] They also added that intraoperative assessment of pulp tissue, and not the preoperative clinical diagnosis, were more reliable in the determination of treatment plan. Elmsmari et al have recommended reporting the status of the restoration and periodontal condition of the failed teeth.[7] Such factors may contribute to the failure of pulpotomised teeth by forming the pathways of microleakage. Uesrichai et al utilised PP for the management of teeth with SIP and apical periodontitis.[9] The favourable result obtained from all these studies supports the rationale of extending the indications of pulpotomy techniques well beyond the conventional recommendation. Interestingly, a study on PP has reported 55% and 83% success in calcium hydroxide and MTA group, respectively, at one year follow up in cariously exposed permanent molars with signs indicative of SIP, emphasising the role of biomaterial in the successful outcome.[10] Hard tissue barrier formation following the pulpotomy procedure is suggested to reduce the chances of leakage.[11]

Vital pulp therapy in permanent teeth

If the pulp is not inflamed, haemorrhage is appropriately managed, a nontoxic capping substance is used, and the capping material and repair shut out microorganisms, vital pulp treatment has a high success rate.[12]

Direct pulp therapy

Direct pulp capping refers to the application of medication to a pulp that has become exposed when the final portions of deep dental cavities are excavated. In order to wall off the exposed location and establish a dentin bridge, young, healthy pulps are encouraged to undergo this procedure. A decent general rule of thumb restricts the exposure site's diameter to less than 1.5 mm.[12] The initial stage of the technique is to eliminate any superficial caries before going on to the deeper ones. Controlling the haemorrhage with a sterile cotton pellet wet with sterile saline is the second step. The third stage involves cleaning the cavity for at least one minute with 2.5% sodium hypochlorite, followed by applying calcium hydroxide, or MTA immediately over the exposure site without pushing it into the pulp. The final procedure is to permanently repair the capping material by covering it with glass ionomer.[12] Primary and young permanent teeth that are mechanically or traumatally exposed, the

presence of vital pulp, the absence of a history of spontaneous or irreversible inflamed pulp, normal radiography results, controlled haemorrhage, and restricted restorative therapy are all indicators.[12] Included in the list of contraindications are exposures with purulent or serous exudates, large carious exposures, radiographic evidence of pulpal or peri-radicular pathosis, calcifications in the pulp chamber, and spontaneous discomfort.[12] Several materials have undergone testing and evaluation for pulp capping techniques. Evidence at this time indicates that employing MTA produces superior results when considering the capping material. Aeinehchi and colleagues make study of 11 pairs of third molars (patients 20-25 years old) with mechanically exposed pulps that were capped with either MTA or calcium hydroxide, coated with zinc oxide-eugenol, and restored with amalgam were used to compare the utilisation of MTA and calcium hydroxide in direct pulp capping situations.[13] Extracted teeth were then histologically examined after one week, two months, three months, and six months. In the teeth treated with MTA, odontoblastic layers developed earlier, there was less hyperemia, necrosis, and inflammation, and the dentinal bridges were more noticeable. In a different randomized clinical study, Nair and colleagues used MTA instead of calcium hydroxide cement (Dycal) as the control to study the pulpal response to direct pulp capping in healthy human teeth.[14] As a direct pulp capping agent, MTA was clinically simpler to apply and produced less pulpal inflammation and more predictable hard tissue barrier creation than Dycal. For direct pulp capping methods, MTA or comparable compounds should be used instead of hard-setting calcium hydroxide cements.

PP

PP is described in the glossary of the American association of endodontists as the removal of a small amount of the vital coronal pulp in order to preserve the remaining coronal and radicular pulp tissues and promote continued physiologic development and formation of the root end.[12] Teeth with traumatic pulp exposure in children and young adults can be effectively treated (96%) with PP and calcium hydroxide.[15] Cvek pulpotomy is another name for the operation. Inflammation reached 1.5 mm to 2 mm into the pulp at the 48-hour mark but only 0.8 mm to 2.2 mm after one week, according to research by Cvek and colleagues examining the depth of inflammatory responses of adult monkey pulps exposed by fracture or cavity preparation.[16] Calcium hydroxide must thus come into contact with non-inflamed tissue that is positioned around 2 mm of pulp underneath the exposure site in order to be effective. Fuks and colleagues achieved a 94% success rate for partial pulpotomies on 63 teeth with various types and degrees of traumatic damage in 1987.[17] No associations between healing and pulp exposure size, trauma kind, time period, or root growth were discovered.

A high-speed bur is used in the initial phase of the technique to reach the tooth. The coronal pulp is amputated in the second stage using a sterile round bur and/or a sharp spoon. Cleaning the canal walls with sterile cotton pellets that have been wet is the third step. The fourth step is to push down on the pulp stump with a wet, sterile cotton pellet to prevent bleeding. The pulp wound and cavity are cleaned in the fifth stage using 2% chlorhexidine gluconate, and then MTA, or calcium hydroxide is applied to the pulp stump to a thickness of 2-3 mm. Indications include carious or traumatically exposed primary and permanent teeth, vital pulp, which responds to sensitivity tests, normal radiographic findings, controlled bleeding, and limited to moderate restorative therapy. Contraindications include spontaneous discomfort, radiographic evidence of pulpal or periradicular pathosis, calcifications in the pulp chamber, excessive bleeding encountered, and exposures with purulent/serous exudates.

Complete pulpotomy

The coronal pulp is removed during a pulpotomy, while the radicular pulp is kept. This procedure can be used in one of three ways: by keeping the radicular pulp healthy, rendering it inactive, or by promoting tissue regeneration and healing at the site of radicular pulp amputation.[1] In order to prevent salivary germs from contaminating the pulp chamber, techniques include anaesthesia using the preferred method and isolating the tooth, ideally with a rubber dam. After that, clean up any cavities before going into the pulp chamber. The pulp chamber is next exposed using a #330 carbide bur while being sprayed with water after all cavities have been eliminated. Following the removal of coronal pulp using a round bur and a slow-speed handpiece, hemostasis is established by applying a cotton pellet for no more than five minutes. Pulpotomy is no longer recommended when the pulp tissue is inflamed and hyperemic and hemostasis cannot be accomplished. Such a tooth would require an alternate therapy like pulpectomy or perhaps extraction. Finally, after achieving hemostasis, the material of choice is applied, and the tooth is repaired.[1] Indications include that absence of spontaneous discomfort, no parulis and movement, and tooth must have no radiographic internal or exterior root resorption or furcation radiolucency.

Pulpotomy materials

To sustain primary molars in the dental arch, and to protect the health of the primary radicular pulp a variety of pulpotomy materials are available. A pulpotomy medication should ideally be bactericidal, simple to administer, safe for the surrounding structures and the residual pulp tissue, not interfere with physiologic root resorption, and be reasonably priced. It goes without saying that the perfect dressing material has not been discovered, but research in both endodontics and paediatric dentistry is continually being done in an effort to identify one. Over the past century, pharmacological pulpotomy agents have progressed from devitalization (mummification, cauterization), preservation of the

radicular pulp (minimum devitalization, non-inductive), and tissue regeneration (reparative, inductive) actions.[18] Formocresol (FC), ferric sulphate (FS), sodium hypochlorite (SH), calcium hydroxide (CH), calcium-silicate-based biomaterials including mineral trioxide aggregate (MTA), BiodentineTM, and bioceramic paste/putty are the most widely utilised materials that have been employed over time with acceptable outcomes. Some of the previously listed drugs (FS and SH) are used as stand-alone medications or in conjunction with other medicines to achieve hemostasis, which is a crucial step in the pulpotomy technique. Applying pressure with sterile cotton pellets, either dry or gently moistened in saline solution, is a non-pharmacological method of achieving hemostasis.[19]

Factors that affect pulpotomy results include the inflammatory state of the pulp prior to treatment, the vital pulp therapy procedure selected, the capping material, restorative status, and the depth of caries. Other factors, such as patient age, gender, pulpal bleeding, and tooth type, have been shown to be less significant.[20]

CONCLUSION

The preservation of primary teeth is of utmost importance in pediatric dentistry to ensure normal speech, development, and self-esteem, while also preventing secondary issues such as space loss and tooth impaction. Over time, various pulpotomy techniques and materials have been explored, ranging from mummification to maintaining pulp vitality and promoting healing. In today's conservative dentistry, techniques like indirect pulp treatment and PP have gained popularity. CPT has emerged as a viable option for patients who cannot afford RCT. Indirect and direct pulp therapies have also been examined, considering their indications, contraindications, and the materials used. To find the perfect pulpotomy material that is bactericidal, non-toxic, and supports tissue regeneration, more investigation is required. The review places a strong emphasis on the value of continuous research in this area to enhance the efficacy and long-term success of pulpotomy procedures.

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