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Formocresol, MTA, Biodentine and *Aloe vera* in pulpotomies

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Abstract

Introduction: Pulpotomy is a treatment procedure that can be performed on healthy root pulp tissue with healing potential after surgical amputation of the infected or affected coronal pulp.

Objective: To gather more recent information on the materials that can be used to perform pulpotomy treatments, such as formocresol, biodentine, mineral trioxide aggregate (MTA) and *Aloe vera*.

Methodology: Articles found at PubMed, SCOPUS and Google scholar were analyzed, with an emphasis on the last 5 years. Articles were evaluated with the PRISMA and AMSTAR guidelines. The search was carried out using the words "pulpotomies" in relation with "formocresol", "MTA", "biodentine" and "*Aloe vera*".

Results: Formocresol: It shows 100% favorable clinical success without abscess formation, mobility or drainage on radiographic success. Some complications such as root resorption and pulp canal obliteration can be observed, although it has better results in two appointment treatment.

MTA: The 9-month clinical success rate was 88.23%, while the radiographic success rate was 82.3%. Biodentine: Favorable biological, physical and mechanical properties, its clinical and radiographic success is 100%.

***Aloe vera*:** It is a natural and inexpensive medicine with good clinical and radiographic success in the short term.

Conclusion: The best clinical and radiographic results are found in biodentine and MTA. The disadvantage of these is their manipulation.

Keywords: Pulpotomy, formocresol, biodentine, mineral trioxide aggregate, and *Aloe vera*

1. Introduction

Pulpotomy is a treatment procedure that can be performed on healthy root pulp tissue with healing potential after surgical amputation of infected or diseased coronal pulp [1]. Pulpotomy is mainly used for any primary teeth and young permanent teeth with vital pulp exposure, with a clinical success rate of 83% to 100%. Primary teeth are an important chewing organ during childhood and play a crucial role in the normal eruption of permanent teeth, normal jaw development and overall health of children [2]. Pulpitis is the inflammation of the pulp tissue of teeth in response to harmful stimuli, including bacterial invasion of the tooth structure [3]. Formocresol despite its disadvantages such as cytotoxicity, pulp inflammation, necrosis, systemic alterations, mutagenicity, carcinogenic potential and immunological responses, is the most widely used pulpotomy drug in recent decades with a high success rate, due to its bacteriostatic and fixative properties [4].

Mineral trioxide aggregate (MTA) was introduced in dentistry due to its ability to create a seal and its biocompatibility. In addition, it showed odontoblastic and cementoblastic activities. A calcium silicate-based cement, Biodentine (Septodont, Saint-Maur-des-Fossés, France), required shorter setting times, showed less discoloration and showed favorable clinical results [5]. A polysaccharide obtained from *Aloe vera* gel found that acemannan, when exposed to pulp tissue, caused dentin deposition that occurs by pulp cell proliferation and differentiation into odontoblast-like cells and mineral deposition. Thus creating a dentin barrier on the exposed pulp tissue [6].

Knowing the different materials available to perform pulpotomies and the success of this treatment helps to keep the teeth in the mouth for as long as possible, in this work we review publications about four materials to perform pulpotomies, such as formocresol, MTA, biodentine, and *Aloe vera*.

2. Materials and Methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using PRISMA guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews (AMSTAR-2) [7]. The search was performed using Boolean logical operators AND, OR and NOT. It was realized with the words "pulpotomies", "formocresol", "MTA", "biodentine" and "*Aloe vera*".

3. Results and Discussion

3.1 Formocresol

Formocresol shows a 100% favorable clinical success without abscess formation, mobility or drainage [8]. In radiographic complications root resorption and pulp canal obliteration can be observed [9]. It can be said that formocresol shows a lower radiographic success rate than the clinical [10], and also there are studies where formocresol pulpotomy can be completed without the need for a capping agent [11]. This pulpotomy technique can be performed by limited accesses, thus saving the tooth structure. It is performed in a shorter time than other techniques, which is helpful when a child patient is uncooperative [12]. Regarding postoperative pain, after using formocresol there was no pain [13]. The disadvantages of formocresol are that it affects the DNA of the pulp [14], as well as the teeth seem to have a shorter life because they are exfoliated at a faster rate, i.e. there is a risk of early exfoliation [15].

There is controversy with the use of formocresol due to its cytotoxicity and pulp DNA affection, however, it is a material that has been used for a long time and according to studies it gives good clinical and radiographic results in the short term.

3.2 MTA

MTA may be the best drug for pulpotomies in primary molars. Thanks to its biocompatibility, it has a lower probability of clinical failure and offers good long-term results [16]. It has the advantage that it does not present consequences to its permanent successor tooth [17]. In clinical and radiographic signs, it has good results and there are no differences between them [18], it reduces the failure rate [13], and it also has the advantage that it hardens in the presence of humidity [19]. In the study, Silva *et al.* promoted the mechanisms of pulp repair [20]. However, its disadvantages are the high price and the difficulty of storing it already opened [21], in addition to the fact that it causes the tooth to adopt a gray color, as well as having a long setting time and difficult handling [22]. The clinical success rate in the MTA group was 90%, 84.21% and 88.23% at 3, 6 and 9 months, respectively, with no clinical signs or symptoms reported at these follow-up visits. While the radiographic success rate was 85%, 84.21% and 82.3%, respectively [23]. At 18 months follow-up, it had a 100% success rate [24].

MTA is a biocompatible drug with good clinical and radiographic results in the short and long term; it hardens in the presence of moisture, which makes it a good material of

choice in the presence of moisture.

3.3 Biodentine

The favorable biological, physical, and mechanical properties of Biodentine show that this material can be effectively used as a pulpotomy drug in clinical practice [4]. It exhibits compressive strength, microhardness, flexural strength, sealability and calcium ion release [25]. Biodentine has a mineralization potential [26] and induces pulp regeneration, healing and dentin formation [27], in addition to being biocompatible and having bioactive behavior [1]. It presented a clinical and radiographic success rate of 100% [8], however, it has disadvantages for its manipulation [28], despite the fact that it has a fast setting [29]. It is also observed that it has the capacity for apical closure and an increase in root length [30]. There are different opinions about Biodentine, although it has excellent clinical and radiographic results, it is difficult to manipulate, and its preparation requires more time and instruments for its correct preparation.

3.4 *Aloe vera*

Clinical and radiographic success was determined by grading the presence or absence of pathosis. The result was that there was a good response to *Aloe vera* [6], showing no signs of abscess, mobility or pain after 2 months [31] and demonstrated effectiveness over a period of 6 months [32]. The use of *Aloe vera* promoted pulp cell viability [33]. As well as being a good measure to maintain stem cell viability [34], it also stimulated dentin regeneration in teeth with reversible pulpitis [35]. It functions as an overlay material for partial pulpotomy of immature permanent teeth to induce continuous root formation [36]. Although *A. Vera* is a natural and economically viable drug, it has been shown to be an unfavorable pulpotomy agent in primary teeth [37].

Aloe vera has short term clinical success showing good effectiveness, it is an economical and viable drug but more studies are still needed to confirm its effectiveness.

4. Conclusions

There are advantages and disadvantages in the materials reviewed, but the best clinical and radiographic results are found in the use of biodentine and MTA. The disadvantage of these is their manipulation. Formocresol and *Aloe vera* seems that can replace these materials for pulpotomies with good results in the short term and at low cost, however is necessary more studies to compare.

5. References

- 1 Carti O, Oznurhan F. Evaluation and comparison of mineral trioxide aggregate and biodentine in primary tooth pulpotomy: Clinical and radiographic study. Niger J Clin Pract. 2017 Dec;20(12):1604-1609.
- 2 Tang Y, Xu W. Therapeutic effects of Pulpotomy and Pulpectomy on deciduous molars with deep caries. Pak J Med Sci. 2017 Nov-Dec;33(6):1468-1472.
- 3 Wolters WJ, Duncan HF, Tomson PL, Karim IE, McKenna G, Dorri M, Stangvaltaite L, van der Sluis LWM. Minimally invasive endodontics: a new diagnostic system for assessing pulpitis and subsequent treatment needs. Int Endod J. 2017 Sep;50(9):825-829.
- 4 Ahuja S, Surabhi K, Gandhi K, Kapoor R, Malhotra R, Kumar D. Comparative Evaluation of Success of Biodentine and Mineral Trioxide Aggregate with Formocresol as Pulpotomy Medicaments in Primary Molars: An In Vivo Study. Int J Clin Pediatr Dent. 2020

- Mar-Apr;13(2):167-173.
- 5 Kim Y, Lee DH, Kim HM, Kye MJ, Kim SY. Biological Characteristics and Odontogenic Differentiation Effects of Calcium Silicate-Based Pulp Capping Materials. *Materials (Basel)*. 2021 Aug 18;14(16):4661.
 - 6 Abirami K, Ramkumar H, Senthil D. Clinical and Radiographic Evaluation of the Efficacy of Formocresol, Allium sativum Oil, and Aloe barbadensis Gel as Pulpotomy Medicaments in Primary Molars: A Randomized Controlled Trial. *Int. J Clin Pediatr Dent*. 2020 Sep-Oct;13(5):518-522.
 - 7 Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, *et al*. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ*. 2017;358:j4008.
 - 8 El Meligy OAES, Alamoudi NM, Allazzam SM, El-Housseiny AAM. Biodentine TM. versus formocresol pulpotomy technique in primary molars: a 12-month randomized controlled clinical trial. *BMC Oral Health*. 2019 Jan 7;19(1):3.
 - 9 Olczak-Kowalczyk D, Samul M, Góra J, Gozdowski D, Turska-Szybka A. Ferric Sulfate and Formocresol pulpotomies in paediatric dental practice. A prospective-retrospective study. *Eur J Paediatr Dent*. 2019 Mar;20(1):27-32.
 - 10 Sirohi K, Marwaha M, Gupta A, Bansal K, Srivastava A. Comparison of Clinical and Radiographic Success Rates of Pulpotomy in Primary Molars using Ferric Sulfate and Bioactive Tricalcium Silicate Cement: An in vivo Study. *Int J Clin Pediatr Dent*. 2017 Apr-Jun;10(2):147-151
 - 11 Oliadarani FK, Haghgoo R, Mashhadiabbas F, Kahvand M. Histopathological Evaluation of Dental Pulp of Primary Teeth Pulpotomized with Formocresol with/without a Capping Agent: A Randomized Clinical Trial. *J Int. Soc. Prev Community Dent*. 2018 Sep-Oct;8(5):420-423.
 - 12 Chakraborty A, Dey B, Jana S. A Nonconventional Approach to Formocresol Pulpotomy. *Int J Clin Pediatr Dent*. 2018 Nov-Dec;11(6):490-495.
 - 13 Smaïl-Faugeron V, Glenny AM, Courson F, Durieux P, Muller-Bolla M, Fron Chabouis H. Pulp treatment for extensive decay in primary teeth. *Cochrane Database Syst Rev*. 2018 May 31;5(5):CD003220.
 - 14 Ko H, Jeong Y, Kim M. Cytotoxicities and genotoxicities of cements based on calcium silicate and of dental formocresol. *Mutat Res*. 2017 Mar;815:28-34.
 - 15 Ghoniem N, Vaidyanathan V, Zealand CM, Sushynski JM, Mettlach SM, Botero TM, *et al*. Mineral Trioxide Aggregate and Diluted Formocresol Pulpotomy: Prospective and Retrospective Study Outcomes. *J Mich Dent Assoc*. 2018 Apr;100(4):40-65
 - 16 Waterhouse P. Are different pulp treatment techniques and associated medicaments effective for the treatment of extensive decay in primary teeth? *Evid Based Dent*. 2021 Jan;22(1):12-13.
 - 17 Biedma Perea M, Solano Mendoza B, Garcia-Godoy F, Mendoza Mendoza A, Iglesias-Linares A. Clinical and radiographic evaluation of white MTA versus formocresol pulpotomy: A 48-month follow-up study. *Am J Dent*. 2017 Jun;30(3):131-136.
 - 18 Parirokh M, Torabinejad M, Dummer PMH. Mineral trioxide aggregate and other bioactive endodontic cements: an updated overview - part I: vital pulp therapy. *Int Endod J*. 2018 Feb;51(2):177-205.
 - 19 Silva LLCE, Cosme-Silva L, Sakai VT, Lopes CS, Silveira APPD, Moretti Neto RT, *et al*. Comparison between calcium hydroxide mixtures and mineral trioxide aggregate in primary teeth pulpotomy: a randomized controlled trial. *J Appl Oral Sci*. 2019 May 20;27:e20180030.
 - 20 Youssef AR, Emara R, Taher MM, Al-Allaf FA, Almalki M, Almasri MA, *et al*. Effects of mineral trioxide aggregate, calcium hydroxide, biodentine and Emdogain on osteogenesis, Odontogenesis, angiogenesis and cell viability of dental pulp stem cells. *BMC Oral Health*. 2019 Jul 2;19(1):133.
 - 21 Yildirim C, Basak F, Akgun OM, Polat GG, Altun C. Clinical and Radiographic Evaluation of the Effectiveness of Formocresol, Mineral Trioxide Aggregate, Portland Cement, and Enamel Matrix Derivative in Primary Teeth Pulpotomies: A Two Year Follow-Up. *J Clin Pediatr Dent*. 2016 Winter;40(1):14-20.
 - 22 Zafar K, Jamal S, Ghafoor R. Bio-active cements-Mineral Trioxide Aggregate based calcium silicate materials: a narrative review. *J Pak Med Assoc*. 2020 Mar;70(3):497-504.
 - 23 Satyarth S, Alkhamis AM, Almunahi HF, Abdulaziz Alshaymi MO, Vadde HB, Senapathi SN, *et al*. Comparative Evaluation of Mineral Trioxide Aggregate Pulpotomy and Laser-Assisted Mineral Trioxide Aggregate Pulpotomy: An Original Research Article. *J Microsc Ultrastruct*. 2021 Feb 9;9(1):7-11.
 - 24 Juneja P, Kulkarni S. Clinical and radiographic comparison of biodentine, mineral trioxide aggregate and formocresol as pulpotomy agents in primary molars. *Eur Arch Paediatr Dent*. 2017 Aug;18(4):271-278.
 - 25 Sanz JL, Soler-Doria A, López-García S, García-Bernal D, Rodríguez-Lozano FJ, Lozano A, *et al*. Comparative Biological Properties and Mineralization Potential of 3 Endodontic Materials for Vital Pulp Therapy: Theracal PT, Theracal LC, and Biodentine on Human Dental Pulp Stem Cells. *J Endod*. 2021 Aug 21:S0099-2399(21)00563-X.
 - 26 Rajasekharan S, Martens LC, Cauwels RGEC, Anthonappa RP. Biodentine™ material characteristics and clinical applications: a 3 year literature review and update. *Eur Arch Paediatr Dent*. 2018 Feb;19(1):1-22.
 - 27 Bossù M, Iaculli F, Di Giorgio G, Salucci A, Polimeni A, Di Carlo S. Different Pulp Dressing Materials for the Pulpotomy of Primary Teeth: A Systematic Review of the Literature. *J Clin Med*. 2020 Mar 19;9(3):838.
 - 28 Awawdeh L, Al-Qudah A, Hamouri H, Chakra RJ. Outcomes of Vital Pulp Therapy Using Mineral Trioxide Aggregate or Biodentine: A Prospective Randomized Clinical Trial. *J Endod*. 2018 Nov;44(11):1603-1609.
 - 29 Kaur M, Singh H, Dhillon JS, Batra M, Saini M. MTA versus Biodentine: Review of Literature with a Comparative Analysis. *J Clin Diagn Res*. 2017 Aug;11(8):ZG01-ZG05.
 - 30 Abuelniel GM, Duggal MS, Duggal S, Kabel NR. Evaluation of Mineral Trioxide Aggregate and Biodentine as pulpotomy agents in immature first permanent molars with carious pulp exposure: A randomised clinical trial. *Eur J Paediatr Dent*. 2021;22(1):19-25.
 - 31 Gupta N, Bhat M, Devi P, Girish. Aloe-Vera: A Nature's Gift to Children. *Int. J Clin Pediatr Dent*. 2010 May-Aug;3(2):87-92.

- 32 Subramanyam D, Somasundaram S. Clinical and Radiographic Evaluation of *Aloe vera* vs Formocresol as a Pulpotomy Medicament in Primary Molars: A Double Blinded Randomized Controlled Trial. *Int. J Clin Pediatr Dent.* 2020 Mar-Apr;13(2):138-143.
- 33 Carvalho NC, Guedes SAG, Albuquerque-Júnior RLC, de Albuquerque DS, de Souza Araújo AA, Paranhos LR, *et al.* Analysis of *Aloe vera* cytotoxicity and genotoxicity associated with endodontic medication and laser photobiomodulation. *J Photochem Photobiol B.* 2018 Jan;178:348-354.
- 34 Sholehvar F, Mehrabani D, Yaghmaei P, Vahdati A. The effect of *Aloe vera* gel on viability of dental pulp stem cells. *Dent Traumatol.* 2016 Oct;32(5):390-6.
- 35 Songsiripraduboon S, Kladkaew S, Trairatvorakul C, Sangvanich P, Soontornvipart K, Banlunara W, Thunyakitpaisal P. Stimulation of Dentin Regeneration by Using Acemannan in Teeth with Lipopolysaccharide-induced Pulp Inflammation. *J Endod.* 2017 Jul;43(7):1097-1103.
- 36 Vu TT, Nguyen MT, Sangvanich P, Nguyen QN, Thunyakitpaisal P. Acemannan Used as an Implantable Biomaterial for Vital Pulp Therapy of Immature Permanent Teeth Induced Continued Root Formation. *Pharmaceutics.* 2020 Jul 8;12(7):644.
- 37 Kalra M, Garg N, Rallan M, Pathivada L, Yeluri R. Comparative Evaluation of Fresh *Aloe barbadensis* Plant Extract and Mineral Trioxide Aggregate as Pulpotomy Agents in Primary Molars: A 12-month Follow-up Study. *Contemp Clin Dent.* 2017 Jan-Mar;8(1):106-111.