

Direct Pulp Capping with Mineral Trioxide Aggregate in Primary Teeth: 2 Year Follow-Up

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Abstract: Pulp therapy techniques in primary dentition are similar to those clinically tested and approved in permanent dentition because of new evidences about regenerative and reparative potential of odontoblasts and odontoblastlike cells in pulp of primary teeth. Direct pulp capping (DPC) as a treatment method of reversible pulpitis causes controversy about its level of success and its indications for application in primary dentition. Mineral trioxide aggregate is a biocompatible pulp capping material with excellent hermetic features, antibacterial effect and ability to stimulate the pulp and its cells content for regeneration and new hard tissue production when it is in direct contact with the pulp. This gives us a reason to choose MTA as a pulp capping material in our study. The aim of the study is to implement the DPC with MTA in primary dentition for a treatment of reversible pulpitis, to appropiate its specific clinical protocol and to establish the level of success after 24 mouths follow-up period. Material and methods. Children between 4 and 6 years old were included in the study with at least one deep caries lesion on primary molar or canin. Total number of teeth included in the investigation was 35. It was performed a complete excavation during which the pulp was necessarily exposed up to 1 mm in diameter. The small pulp exposure was covered with MTA paste and the cavity was finished with lining of glasjonomer cement and compomer and adhesive system as a permanent filling. All cases were followed up clinically at 6 months, 1 year and 2 years after the treatment and radiographically at first and second year after treatment. Results: The success rate after first follow up period is 82,86% of clinical success and then at first and second year after treatment all other teeth were classified as successful according to clinical and radiographic criteria of success. Conclusion: Direct pulp capping as a method of choice for treatment of reversible inflammation of the pulp of primary teeth has its advantages which should be proven through more quality studies.

Keywords: Direct pulp capping, Mineral trioxide aggregate, primary teeth, regeneration, reversible pulpitis

1. Introduction

The structural and physiological characteristics of the pulp and dentin-pulp complex of primary teeth are similar to those in permanent teeth ([2],[3]). Large number of investigations and their positive results in primary teeth give us a reason to rely on the protective abilities of odontoblasts and odontoblast-like cells in treatment of reversible inflammatory diseases of the pulp ([4]). The aim is to stimulate the regenerative and reparative processes in order to maintain its vitality. Pulp therapy techniques in primary dentition are similar to those clinically tested and approved in permanent dentition. Vital methods of treatment in primary dentition are classified as ([5],[6],[7]):

Indirect pulp capping-Ca(OH)₂
Direct pulp capping - Ca(OH)₂, MTA
Vital pulpotomy (partial and total) ([7])

- Devitalization- formocresol, electrosurgical pulpotomy, laser pulpotomy
- Preservation – glutaraldehyde, ferric sulphate
- Regeneration- Ca(OH)₂, MTA

Direct pulp capping (DPC) as a method of treatment of reversible pulpitis causes controversy about its level of success and its indications in primary dentition. Some authors have reported a low level of positive results and a high risk of internal resorption, dentoalveolar abscess, sinus tract and pathological mobility ([8],[9],[10],[11]), but others have published promising results – between 93% and 100% success([12],[13],[14],[15],[16]). Rodd et al., Garrocho-Rangel et al., Ni Chaollai et al.([5],[13],[16])have shared

that there is a lack of investigations of a good quality about efficacy of the method and consensus about the specific technique for the procedure and the best pulp capping material, which would provide the healing processes. One of the most popular medicaments for DPC is Ca(OH)₂ ([8],[13],[17],[18]), but better results are registered by the use of Mineral trioxide aggregate (MTA) ([14],[15],[19]), biocompatible material, with excellent hermetic abilities which stimulates the regenerative potential of the pulp, provide its vitality and maintain healing processes in it.

The aim of this study is to implement a treatment of reversible pulpitis of primary teeth by DPC with MTA, to appropiate its specific technique and to establish the level of success after 24 mouths follow-up period.

2. Material and Methods

Patients between 4 and 6 years old were included in the study. Their parents (or legal guardians) were informed about the necessary treatment and it was obtained an informed consent from them. Patients had at least 1 primary molar or canin with deep caries lesion with proximal or occlusal localization.

Diagnose “reversible pulpitis” was stated after obtaining a detailed information about general condition, clinical and radiographic examination. All teeth included in the study were covering the following criteria: presence of deep caries lesion, clinically detected, there was no history of spontaneous/ night pain, there were no swelling, redness, abscess or sinus tract. It was possible to detect presence of provoked pain of cold or chewing pressure, which was lasting no longer than a minute. There was no sensitivity of percussion or palpation, the radiographic examination

presented deep caries lesion, close to the pulp chamber, root resorption had to be no more than 1/3 of the normal root length, there had not be observed any pathological changes in periapical and furcal regions. Teeth with these characteristics are suitable for vital methods of pulp treatment- indirect pulp capping (IPC) or direct pulp capping. Method of treatment was chosen during the clinical visit. We performed a complete excavation on enamel-dentin junction, buccal and lingual and gingival walls, but over the pulp wall we tried to keep a thin layer of demineralized dentin. It is evident that in many clinical cases pulp exposure is inevitable and IPC is impossible to be performed. In those cases DPC and partial pulpotomy are treatment methods of choice. Indications to perform DPC were: pulp exposure up to 1 mm and bleeding stop up to 2 min.

All 35 clinical cases in our study covered all the criteria for performing DPC. Other cases which had not covered the criteria were receiving another biological treatment.

Treatment protocol:

- Local anaesthesia (Ubistesin, 3M, ESPE) and tooth was isolated with cotton rolls.
- The carious dentin was cleaned on the enamel- dentin junction with round steel bur. Over the pulp wall it was left a thin layer of demineralized dentin but over the pulp exposure it was left a cotton pallet soaked with sterile saline for 2 min.
- Pulp exposure was covered with a thin layer of Mineral Trioxide Aggregate (MTA, Angelus, Brasil);

- Over the MTA layer it was placed a liner of glassionomer cement (Ketac molar easymix, 3M, ESPE);
- The cavity was sealed with compomer and adhesive system (Dyract XP, Dentsply, Meileffer).

Follow- up period:

- The follow-up visits were scheduled at 6 months, 1 year and 2 years;
- The radiographic control was scheduled at 1 years and 2 years after the treatment.

Criteria of clinical success:

- No pain, swelling, redness, or sinus tract;
- Obturation in a good condition, no fractures or secondary caries.

Criteria of radiographic success:

- Normally continuing physiological resorption;
- No pathological changes in periapical and intraradicular regions;
- No internal or pathological external resorption;
- Presences of newly formed dentinlike bridge over the pulp exposure.

3. Results

From all 35 cases of reversible pulpitis of primary teeth, treated by DPC with MTA, 29 of them (82,86%) covered all the criteria for clinical and radiographic success through all follow- up periods (table 1).

Table 1: All the cases of reversible pulpitis of primary teeth, treated by DPC with MTA divided according to clinical outcome- successful or unsuccessful

Follow up Number of treated teeth	After 6 months		After 1 year		After 2 years	
	successful number %	unsuccessful number %	successful number %	unsuccessful number %	successful number %	unsuccessful number %
35	29 82.86	6 17.14	29 82.86	0 0	29 82.86	0 0

Six teeth (17.14%) dropped out because of registered complications after the treatment and they received different treatment. Two of these cases developed abscess, with spontaneous pain, swelling and redness of the gingiva around the treated tooth. The other four cases of failure there was no pain, but they developed periapical osteitis with sinus tract.

All criteria of clinical and radiographic success covered 29 of all teeth treated by DPC with MTA or that was 82,86 % of all.

In table 2 are presented the results of clinical examinations after the treatment.

Table 2: Results of clinical control visits of all cases treated by the method of direct pulp capping with MTA

Criteria for clinical success	After 6 months	After 1 year	After 2 years
Absence of pain	33/35	29/29	29/29
Absence of swelling, redness or sinus track	29/35	29/29	29/29

Absence of fractures to obturations and secondary caries	35/35	29/29	29/29
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Six months after treatment 29 of all 35 cases were classified as successful according to clinical and radiographic criteria of success. Four of the failure cases developed sinus track, but other two of them developed dentoalveolar abscess with swelling and redness on the gingiva. Only two of the failures had history of spontaneous pain after treatment. All 35 treated teeth had obturations of a good quality on the first follow up period; there were no fractures or secondary caries around the edges of obturations.

All 29 treated teeth been successful after first follow up period cover the clinical criteria for success at 1 year after treatment and 2 year after treatment. There is no cases of swelling, redness or sinus track registered, no history of pain and the quality of obturations had not been compromised during the follow up period.

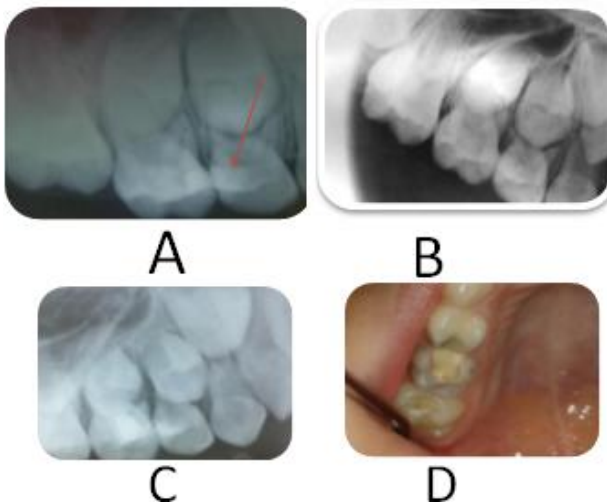
On table 3 are presented results according to criteria for radiographic success

Table 3: Results of radiographic control of successfully treated by DPC with MTA primary teeth diagnosed with reversible pulpitis

Criteria of radiographic success	After 1 year	After 2 years
Absence of periapical or furcal pathology	29/29	29/29
Absence of internal resorption	29/29	29/29
Absence of pathological external resorption	29/29	29/29
Presence of newly formed dentinlike bridge	5/29	5/29
Normally advanced physiological resorption	29/29	29/29

At 1 and 2 years after the treatment control X-rays had been made and all 29 cases left successful after the first follow up period were classified as successful till the end of the study according to radiographic criteria. Newly formed dentinlike bridge over the pulp exposure had been observed in 5 of all 29 cases. In the other 24 cases dentinlike bridge had not been observed but normally advanced physiological resorption and absence of any developing pathology- clinical or radiographic was a sign that the pulp was kept vital and protected.

Clinical case of successfully treated primary molar (tooth 54) with reversible pulpitis by Direct pulp capping with MTA.



A.B. 5 years old, diagnose of tooth 54 was “reversible pulpitis”(A)X-ray made right after direct pulp capping with MTA. The arrow points the communication with the pulp.(B)Control X-ray 1 year after treatment. There is absence of pathological changes in intraradicular and periapical spaces, no internal or external resorption, physiological root resorption advances normally.(C)Control X-ray 2 years after treatment. Advanced physiological resorption is observed, no pathological radiographic changes are observed which is a sign of successful outcome(D)A picture of the treated tooth 2 years after DPC, there are no fractures or secondary caries around the obturation. The discoloration around the edges is a result of the use of grey MTA (side effect).

4. Discussion

There is a discussion in the scientific literature about the efficiency and indications for application of direct pulp capping as a method of treatment of exposed due to caries pulp in primary dentition. In large number of scientific publications and guidelines the method is recommended but only in cases of traumatic or incidental exposure of the pulp during cavity preparation ([5],[6],[20],[21],[22]). In 2006 British Association of Pediatric Dentistry in its guideline of pulp therapy said that direct pulp capping has limited indications in primary dentition and they do not recommend it, but also pointed out that there are not enough studies of good quality in this sphere ([5]). Besides that there is no consensus about the specific technique of the method which will increase its efficiency in primary dentition ([5],[13],[16]). There have been made number of investigations which study the pulp response of primary teeth to different pulp capping materials applied for DPC. The level of success is variable but best results are published for MTA (Tuna et al. -100% success ([15])), which has excellent hermetic features, isolates the pulp and protects it from bacterial reinfection ([26]). MTA has antibacterial characteristics, stimulates odontoblastlike cells to differentiate and to produce dentinlike hard tissue ([23],[24],[25],[26]), but the newly formed dentinlike bridge has less tunnel defects and better structural features in comparison with that formed under Ca(OH)₂ cement, which is said to be the gold standard for this kind of treatment ([27],[28]). This gives us a reason to choose MTA as a pulp capping material in our study. We selected cases of reversible pulpitis of primary teeth in which the pulp was exposed necessarily during the cavity preparation and carious dentin excavation. Our study showed 82,86 % successful results and it is an evidence for high efficiency of direct pulp capping as a method of treatment of reversible pulpitis in primary teeth.

5. Conclusion

Our study with its clinical and radiographic evidences of success shows that direct pulp capping with MTA, applied as a treatment method for reversible pulpitis in primary teeth demonstrates very good results - 82,86% success. It gives a chance for microinvasive approach to the pulp and way to save its vitality. This method is an alternative to formalin-resorcin method which is questioned lately because of many concerns about its safeness and has a lot of opponents. The method of DPC is “one visit” method and consume reasonably little chair time for the patient. The main advantages of DPC are the chance to save the pulp vitality, to provide the healing processes and in this way to keep the tooth in dental arch till its physiological exfoliation and to provide normal root resorption.

Direct pulp capping as a method of choice for treatment of reversible inflammation of the pulp of primary teeth has its advantages which have to be proven through more quality studies.

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