CLINICAL AND RADIOGRAPHIC ASSESSMENT OF VITAL PULPOTOMY IN PRIMARY MOLARS USING MINERAL TRIOXIDE AGGREGATE AND A NOVEL BIOACTIVE CEMENT

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ABSTRACT

Background: Pulpotomy is the most frequently used treatment to maintain primary molars with carious involvement, symptomless or with reversible pulpitis.

Aim: The present study was conducted to assess clinically and radiographically the success rate of Biodentine™ pulpotomy in human primary molars and compare it to that of MTA.

Materials & Methods: 52 mandibular primary molars requiring pulpotomy in 22 patients (3-7 yrs) were included in this study. Molars were divided into two groups; Group I: 25 molars received MTA pulpotomy and Group II: 27 molars received Biodentine™ pulpotomy. All pulpotomized teeth were restored with GI and stainless steel crowns. Immediate postoperative radiograph is then taken. Subjects were monitored both clinically and radiographically at 1, 3 & 6 months.

Results: For patients attended the follow up appointments, MTA and Biodentine™ showed 100% success rates both clinically and radiographically.

Conclusion: MTA and Biodentine™ are highly recommended as pulpotomy medicaments in primary molars.

KEY WORDS: Pulpotomy, Primary molars, MTA, Biodentine™.

INTRODUCTION

Pulpotomy is the most frequently used treatment to maintain primary molars with carious involvement, symptomless or with reversible pulpitis which otherwise would be extracted. Its objective is to preserve radicular pulp, avoid pain, inflammation and, maintain the tooth  

After amputation of the inflamed coronal pulp, recovery of the noninflamed radicular pulp can develop along one of three lines: •Devitalization: radicular pulp becomes non vital and nonfunctional, for example formocresol. •Preservation: radicular pulp demonstrates minimal changes (reversible), as ferric sulfate. • Regeneration: radicular pulp is not only vital and functional, but is also stimulated to

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form dentine bridge. Mineral Trioxide Aggregate (MTA) is a typical example \(^2,3\). So with the introduction of new Bioactive materials, the emphasis has shifted from mere preservation to regeneration \(^4\).

MTA is a fine hydrophilic powder \(^5\) developed by Torabinejad in Loma Linda University \(^6\). It consists of tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and bismuth oxide \(^7\). MTA is currently being used in pulp therapy and had provided an enhanced seal over vital pulp and is nonresorbable \(^8,9\). Furthermore, MTA has superior biocompatibility and is less cytotoxic than other materials traditionally used in pulp therapy \(^6\).

MTA liberates cytokines from bone cells, indicating that it actively promotes hard tissue formation \(^10\). It has been proved that MTA has antimicrobial properties similar to Zinc Oxide Eugenol \(^11\). MTA has been recommended as a potential medicament for pulpotomy \(^12-14\), pulp capping, apexification, repair of root perforation \(^15\) and repair of resorptive defects \(^16,17\).

The main drawbacks of MTA are slow setting kinetics and complicated handling, which rendered this technique sensitive procedure, even more difficult and restricted their use to specialists \(^18\).

Biodentine™ (hydraulic silicate cement) is a new class of dental material which could conciliate high mechanical properties with excellent biocompatibility and bioactive behavior. In addition to the chemical composition based on the Ca3SiO5 – water chemistry which brings the high biocompatibility of MTA based cements increased physico-chemical properties (short setting time, high mechanical strength) made Biodentine™ clinically easy to handle and compatible \(^19,20\).

Based on all its properties, Biodentine has been claimed to be a bioactive dentine substitute, with perfect sealing ability, for direct pulp capping, pulpotomy, repair of root perforation, apexification and retrograde root filling \(^15\). A modified powder composition, the addition of setting accelerators and softeners, and a new predosed capsule formulation for use in a mixing device, largely improved its physical properties making it much more user-friendly with shorter setting time \(^21,22\).

Hence, the present study was conducted to assess clinically and radiographically the success rate of Biodentine™ pulpotomy in human primary molars and compare it to MTA.

**MATERIALS AND METHODS**

52 lower mandibular molars requiring pulpotomy in 22 patients selected from the outpatient clinic of Pedodontic Department, Faculty of Oral and Dental Medicine, Cairo University were included in this study. Patients included 12 boys and 10 girls (3 - 7 yrs old); all of them were healthy and cooperative.

Research Ethics Committee approval was obtained from Faculty of Oral and Dental Medicine, Cairo University. Full detailed treatment plan was explained to the children’s parents and informed written consents for treatment and radiographs were obtained prior to clinical procedures.

The criteria for tooth selection were:

1. Mandibular primary molars with vital carious pulp.
2. Lack of clinical evidence of pulpal degeneration (pain on percussion, history of swelling or sinus tracts).
3. Absence of radiographic changes of internal or external resorption and no furcation radiolucency (Preoperative radiograph).
4. Restorable molars.

Molars were divided into two groups; Group I: 25 molars received MTA pulpotomy and Group II: 27 molars received Biodentine™ pulpotomy.

The pulpotomies were performed by the same operator. After performing local anesthesia, all teeth were isolated with a rubber dam and dental caries were removed with a slow-speed round bur No.5
before pulpal exposure. The entire roof of the pulp chamber was then removed using round bur No.5 mounted in a water-cooled high speed turbine. The coronal pulp was amputated using a sharp spoon excavator and the pulp chamber was irrigated with a light flow of normal saline. Moistened cotton pellets were placed over the pulp stumps, and high pressure was applied (1-3 min). When the cotton pellets were removed homeostasis was apparent.

For Group I: According to the manufacturer’s instructions, MTA powder was mixed with sterile water in a 3:1 powder/water ratio to obtain a thick creamy paste, then placed on the floor of the pulp chamber using a messing gun and compacted against the pulp orifices with a condenser over a moist cotton pellet. The cavity was filled with Glass ionomer cement (Riva self cure, SDI, Australia) and finally restored with stainless steel crowns (3M, ESPE, Unitek, United States). An immediate postoperative radiograph using periapical film size 2 (Speed D Film, Kodak, United States) was taken.

For Group II: Biodentine™ capsule was gently tapped on a hard surface (to diffuse powder); five drops of liquid from the single dose dispenser were poured into the capsule which was placed in a triturator for 30 sec. The mixture of Biodentine™ was then introduced into the pulp chamber using amalgam carrier, and the procedure was completed as before.

All pulpotomized teeth were followed up clinically and radiographically (using periapical films size 2) by another pediatric dentist, who did not know which tooth received which material at 1, 3 and 6 months, Figs(1,2).

After that patients were instructed to periodically every 6 month for clinical and radiographic evaluation of treated teeth (1).

The outcome was determined by the following clinical and radiographic criteria: • The presence of any signs such as spontaneous or nocturnal pain, gingival inflammation, tenderness to percussion or palpation, abscess, swelling, fistula and pathologic mobility. • The width of lamina dura of the pulpotomized teeth compared to the immediate postoperative radiograph. • The presence of any signs of pathologic external or internal root resorption as well as periapical or inter-radicular radiolucency.

- Data were collected and statistically analyzed.

<table>
<thead>
<tr>
<th>Material</th>
<th>Composition</th>
<th>Manufacturer</th>
<th>Lot #</th>
</tr>
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<tbody>
<tr>
<td>ProRoot MTA</td>
<td>Tri-calcium silicate</td>
<td>Angelus- Londrinal, PR, Brazil</td>
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<td></td>
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<td></td>
<td>Tri-calcium aluminate</td>
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<td></td>
<td>Tetra-calcium-alumino-ferrite</td>
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<tr>
<td></td>
<td>Calcium sulfate dihydrate</td>
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<td></td>
<td>Bismuth oxide</td>
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<tr>
<td>Biodentine™</td>
<td>Powder: Tri-calcium silicate</td>
<td>Septodont, Saint Maur des Fosse’s, France</td>
<td>B02150</td>
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<tr>
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<tr>
<td></td>
<td>Iron oxide</td>
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<td></td>
<td>Zirconium oxide</td>
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<td>Liquid: Calcium chloride</td>
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<td>Hydrosoluble polymer</td>
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RESULTS

52 lower primary molars requiring pulpotomy in 22 patients were included in this study. Patients included 12 boys (54.5%) and 10 girls (45.5%). Their ages ranged from 3 to 7 years (mean 5yrs).

Patients were divided into two groups; Group I: 25 molars (48.1%) in 17 patients (11 boys & 6 girls) received MTA pulpotomy and Group II: 27 molars (51.9%) in 21 patients (11 boys & 10 girls) received Biodentine™ pulpotomy.

Of all patients, 45 molars (86.5%), 44 molars (84.6%) and 38 molars (73.1%) were available for the 1, 3 and 6 month follow up respectively.

For Group I (MTA pulpotomy): 24 molars (96% of Group I & 46.2% of total), 22 molars (88% of Group I & 42.3% of total) and 18 molars (72% of Group I & 34.6% of total) were available for the 1, 3 and 6 month follow up respectively.

For Group II (Biodentine™ pulpotomy): 21 molars (77.8% of Group II & 40.4% of total), 22 molars (81.5% of Group II & 42.3% of total) and 20 molars (74.1% of Group II & 38.5% of total)
were available for the 1, 3 and 6 month follow up respectively.

For all patients attended the follow up appointments, MTA and Biodentine™ showed 100% success rates both clinically and radiographically at 1, 3 and 6 months.

**DISCUSSION**

The objective of pulp therapy in a child patient is the successful treatment of a pulpally involved tooth and to retain the tooth in a healthy condition so that it may fulfill its role as a useful component of a primary and young permanent dentition (23).

This research intended to assess clinically and radiographically the success rate of Biodentine™ pulpotomy in human primary molars and compare it to that of MTA.

Children from 3 to 7 years of age with mandibular first and second primary molars requiring pulpotomy were included in this study, irrespective of their sex. The age group was selected taking into consideration the lack of cooperation of younger children and physiologic root resorption in elder ones. Mandibular molars were chosen in this study because they show more accurate radiographic interpretation than maxillary ones.

The pulpotomies were performed by the same operator to avoid individual variations of different operators. Group I received MTA pulpotomy and Group II received Biodentine™ pulpotomy. All pulpotomized teeth were finally restored with GI cement and stainless steel crowns which represent the most effective long-term restoration for pulpotomized primary teeth (1).

A postoperative radiograph was obtained immediately following the procedure to document the quality of treatment and to help determine the prognosis. This image also would serve as a comparative baseline for future films.

All pulpotomized teeth were followed up clinically and radiographically at 1, 3 and 6 months by another Pediatric dentist, who did not know which tooth received which material was being evaluated (blind study).

Since failure of a primary molar pulpotomy may be evidenced in the furcation, posterior tooth pulpotomies should be monitored by radiographs that clearly demonstrate the intraradicular area, therefore a periapical radiographs were selected in this study.

Patients were instructed to come every 6 month for clinical and radiographic evaluation, where pulpotomized teeth should be evaluated periodically every 6 month, according to the guidelines of the American Academy of Pediatric Dentistry, 2009 (1).

The results of the present study supported the claimed similarities between Biodentine™ and MTA showing 100% success rates of all molars (Group I & II) available at the follow up appointments. This could be attributed to proper case selection, proper isolation, high aseptic standards, proper technique protocol and appropriate use of medicament. Excellent sealing ability of materials used, biocompatibility, alkalinity and ability to regenerate the hard tissues could also play a role (9, 24, 25).

These results are supported and explained on histological basis by Shayegan, 2009 who observed that Biodentine™ like MTA, promoted beneficial calcification in contact with vital pulp after pulpotomy and direct pulp capping in primary teeth of pigs (26).

Many studies have addressed MTA as a potential alternative to formocresol pulpotomy in primary teeth. These studies showed 100% success rate of MTA, both clinically and radiographically, through different follow up protocols (12-14). Slow setting kinetics and complicated handling rendered MTA pulpotomy technique sensitive and restricted its use to specialists (18).
Biodentine is similar to the usual calcium silicate based materials; therefore, several physical, chemical and biological properties are comparable to MTA. However, manufacturers claims that Biodentine™ has some superior features: better consistency suited to clinical use, its presentation ensures better handling and safety, as the setting is faster, there is a lower risk of bacterial contamination, in addition to its ability to be used as a dentine substitute. Therefore, its use is advantageous for both the clinician and the patient\(^{25}\).

- Biodentine™\(^{(19)}\) is characterized by decreased setting time (9-12 min compared to several hours for MTA) due to presence of calcium chloride accelerator and decreasing the particles size as well as the water content of the system. It exhibits higher early strength and higher reactivity\(^{(20, 27)}\). Moreover the final mechanical strength is increased due to elimination of aluminates and other impurities.

Biodentine™ has been claimed to be one of the most biocompatible biomaterials. In the case of direct pulp capping and pulpotomy in pigs, this compatibility with the pulp enables a direct contact with fibroblasts with limited inflammation\(^{(28)}\).

**CONCLUSIONS**

From the previous study it can be concluded that Biodentine™ and MTA can be used successfully for pulpotomy in primary molars with comparable results. Other factors may affect the selection of the material such as consistency of the material, setting time, handling characteristics, safety and risk of bacterial contamination and cost.

The present available literature is an important tool for rationalizing correct clinical decisions. This is why the scientific efforts to improve do not stop and include new concepts and treatment strategies in order to reduce the incidence of adverse effects and increase biocompatibility.

**REFERENCES**


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