



COMPARATIVE EVALUATION OF TRICALCIUM SILICATE, MINERAL TRIOXIDE AGGREGATE AND CALCIUM HYDROXIDE AS DENTAL PULP CAPPING MATERIALS: AN IN-VIVO STUDY.

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ABSTRACT

Introduction: The problem that dentistry has been facing is to integrate the new materials with potential of healing forming hard tissue during dental treatment.

Objective: Clinical and radiographic assessment of reparative dentin formation using Tricalcium Silicate (Biodentine), MTA and Ca(OH)_2 as pulp capping agents.

Methods: 114 asymptomatic carious teeth involving inner third dentine were treated randomly with one of the pulp capping agents and Fuji IX GIC. They were assessed in 2nd and 6th month with final restoration (composite/amalgam) in 6 month if asymptomatic.

Results: The overall analysis indicated few failure in the *Biodentine group* (7.9%; $n=3$) and *MTA group* (2.6%; $n=1$) than in the *Ca(OH)₂ group* (0%; $n=0$). On comparison between Biodentine and MTA using *Chi Square Fisher's Exact Test* ($=.615$), revealed no significant difference between the group.

Conclusion: This study provided evidence to use Biodentine as an indirect pulp-capping agent as compared with MTA and Ca(OH)_2 .

KEYWORDS : Pulp Capping, MTA, Biodentine, Ca(OH)_2

Introduction

Dental caries is one of the most prevalent infectious diseases in the world. Bacteria causing caries are responsible for the disease initiation and progression which results in dissolution of hard tissue enamel and dentine followed by pulpal tissue damage (Paul R. Cooper, et al., 2010). Formation of hard tissue barrier to protect the underlying pulpal tissue is the sole aim of treating decayed tooth (Marjorie Zanini, et al., 2012). However, from the past twenty years, scientists have been trying to incorporate the results of new concepts in research during dental treatment into the issue of maintenance of tooth structure and function (Dimitrios Tziafas, 2010).

Ever since the discovery of the property of Calcium Hydroxide Ca(OH)_2 , it has been the material of choice among the available pulp-capping materials. However, Ca(OH)_2 has potential issues, like it does not bond to dentin and dissipates over time, and hard tissue bridges adjacent to the material may contain multiple tunnel defects (Cox CF, et al., 1996).

Mineral trioxide aggregate (MTA) has become popular as an alternative to Ca(OH)_2 for treating pulp wounds. Studies reveal, MTA stimulates formation of dentin bridges faster than Ca(OH)_2 , with better pulpal healing, and thus, the better treatment outcome (Min KS, et al., 2008; Eskandarizadeh A, et al., 2011; Avina Paranjpe, et al., 2010).

Alike MTA, Biodentine (Septodont, Saint Maur des Fossés, France) is a new calcium silicate-based restorative cement claiming to have dentin-like mechanical properties, which can be used as a dentin substitute on crowns and roots (Koubi G, et al., 2013). It has shown a

positive effect on vital pulp cells and stimulates dentin like tissue formation (Alicja Nowicka, et al., 2013). While some of the pulp capping agents has been studied extensively, there is newer pulp capping agents with potential of hard tissue formation yet to be studied (Claudia Brizuela, 2017). In this research, the newer generation promising pulp capping agents was studied in clinical setup.

Materials and Methods

Study Design and Participants

This study was a single blind randomized clinical trial with 3 parallel experimental groups. The study was carried out from January 2014 to September 2014 and was assessed and agreed to by the institutional ethics committee of the B. P. Koirala Institute of Health Sciences (IERB/213/014), and designed following the CONSORT guidelines.

The patients enrolled were from University Dental College at Dept of Conservative Dentistry and Endodontics after an informed consent was signed.

Inclusion and Exclusion Criteria

The inclusion criteria were patients between 15 to 60 years old with no history of irreversible pulpitis, deep caries involving inner third of the dentin and no radiographic abnormality.

The exclusion criteria were patients who could not be followed up, history of irreversible pulpitis when assessed with refrigerant spray (Endoice, Hygenic, Coltene/Whaledent Inc., Cuyahoga Falls, OH 44223) and radiographic abnormality within and around root with caries involving pulp.

Determination of the Sample Size

The sample size was calculated based on statistical analysis. Total of 114 individuals were recruited in the study out of which 69 were female and 45 were male.

Clinical Procedure

The operators were 1 endodontic postgraduate students and 2 faculties. Tooth was assessed for features of irreversible pulpitis by means of cold refrigerant (Endo Ice, Hygienic; Coltene/Whaledent) and electrical stimuli (Diagnostic Unit; SybronEndo, Orange, CA). Local anesthetic (2% lidocaine hydrochloride with epinephrine 1:80,000; Septodont) was dispensed by buccal infiltration (upper teeth) or by inferior alveolar nerve block (lower teeth). The procedure was carried under loupes at magnification of 2.5 (Heine Optotechnik, Herrsching, Germany). For isolation purpose, a rubber dam was used in all cases (Hygienic; Coltene/Whaledent AG). The caries removal was carried out by sterile round bur (St. Petersburg, FL, 33709) in a high speed handpiece (NSK, Nakanishi Inc., Tochigi, Japan). Once caries was adequately removed with remaining hard surface dentin, the tooth was randomly assigned to one of the experimental groups by using a computer generated table in Microsoft Excel (Microsoft Corp, Redmond, WA).

Experimental Groups

In group 1, Biodentine (Septodont) was mixed as per manufacturer's guideline and applied on the pulpal floor in the cavity.

In group 2, white Angelus MTA (Angelus Indústria de Produtos Odontológicos S/A, Londrina, Brazil) was mixed as per manufacturer's guideline. The mix was applied on the pulpal floor in the cavity.

In group 3, Dycal (Dentsply Caulk, Milford, USA) was dispensed on a paper pad and carried into cavity with dycal carrier. The mixing took place inside the cavity.

Once the materials were set, intermediate restoration (Fuji IX, GC Asahi Corp, Japan) was placed over the experimental materials. Final restoration was done after 6 months with composite (Surefil, Dentsply Caulk), if tooth was asymptomatic. Patients were recalled at 1 week, 2 months, and 6 months. The sensitivity tests (thermal and electrical) and radiographic examination were carried out in every follow-up with beam aligning device. Clinical success was determined as a tooth with no pain, normal sensitivity tests, no resorption, no periradicular disease, periodontal ligaments within normal limits, and no sinus.

Statistical Analysis

The Chi Square Fisher's Exact Test was executed with the level of significance was set at $P < .05$.

Results

A total of 114 patients were recruited in each group of which 45 were male and 69 female. Table 1 shows the baseline data.

TABLE 1. Description of Baseline Variables by Type of Treatment Assigned

Overall Assessment	All (n=114)	Biodentine (n=38) [Group=1]	MTA (n=38) [Group=2]	Ca(OH) ² (n=38) [Group=3]
	% n	% n	% n	% n
	100	33.33	33.33	33.33
Success	96.5 % (n=110)	92.1% (n=35)	97.4% (n=37)	100% (n=38)
Failure	3.5 % (n=4)	7.9% (n=3)	2.6% (n=1)	0% (n=0)
Gender Distribution	% n (n=)	% n (n=)	% n (n=)	% n (n=)
Male	100% (n=45)	31.1% (n=14)	33.3% (n=15)	35.6% (n=16)
Female	100% (n=69)	34.8% (n=24)	33.3% (n=23)	31.9% (n=22)

Patients Age	Mean [Std Dev] (Range)	Mean [Std Dev] (Range)	Mean [Std Dev] (Range)	Mean [Std Dev] (Range)
	30.8 [11] (15-60)	28.7 [9.7] (17-48)	34.3 [12.1] (15-60)	29.5 [10.5] (15-53)

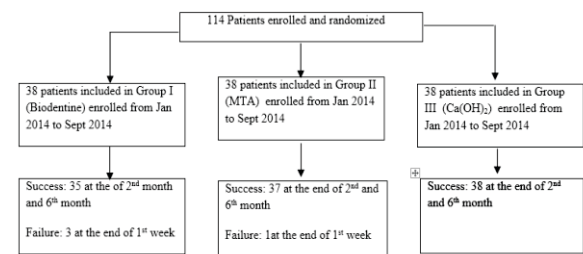


Figure 1: Flow diagram of cases included in the study

There was 3 (7.9%) failure in Biodentine group and 1 (2.6%) in MTA group with no failure (0%) in Ca(OH)₂ group.

A flow chart of the overall picture is portrayed in Figure 1.

According to the Fisher exact test, there were no statistically significant differences among the groups compared between MTA and Biodentine materials studied at the different time intervals ($P=0.615$). No comparison was made with Ca(OH)₂ group as it faced no failure.

Discussion

Pulpal preservation is paramount for various reasons; to allow odontoblasts to create a hard tissue barrier between the pulp and the dressing material, and to maintain pulp function (Aguilar P & Linsuwanont P, 2011).

Though, calcium hydroxide is traditionally the material of choice in deep carious treatment, response to a MTA applied in deep cavities, was found to be biocompatible and superior to calcium hydroxide (TJ Hilton, et al., 2013).

Newer generation materials like Biodentine had a similar efficacy in the clinical setting and may be considered an alternative to MTA and Ca(OH)₂ (Alicja Nowicka, et al., 2013). It is capable of inducing odontoblast differentiation of human dental pulp cells (hDPSCs) and forms calcium silicate hydrate and calcium hydroxide (Xiaohong Wang, et al., 2008).

On evaluation of subjects clinically and radiographically, at the end of six months, we had few failure in the Biodentine group (7.9%; n=3) and MTA group (2.6%; n=1) than in the Ca(OH)₂ group (0%; n=0). The findings of our study sparks debate among cariologists and endodontologists whether indirect pulp treatment is a approach to pulp preservation in teeth with deep carious lesions (Seale NS & Glickman GN, 2008). The failure was due to the poor choice of the case. The major limitation would be short term follow up with more than 2 years follow up required and to study the quality of tertiary dentine formed at histological level.

With these shortcomings, Biodentine can be effectively used for indirect pulp cap treatment, and has opened an avenue to carry out further studies with search for materials that can revert inflammation with possibility to restore tooth to its natural state.

Conclusion

In conclusion, this randomized clinical trial, conducted for up to 6 months within an academic institute, provided confirmatory evidence for a performance with Biodentine as an indirect pulp-capping agent as compared with MTA and Ca(OH)₂.

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The authors do not have any conflict of interest pertaining to this study.

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