

Clinical and Radiological Success Rates of Biodentine for Pulpotomy in Children

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ABSTRACT

Introduction: Formocresol pulpotomy in primary teeth is commonly accepted method in many countries. Current studies have reported limitations of formocresol technique for vital amputation and favour the use of biodentine for vital pulpotomy as it is a biocompatible material and its sealing ability is superior to other available alternatives. Study aimed to find out the clinical and radiological success rate of biodentine for pulpotomy in children visiting Nishtar Institute of Dentistry, Multan, Pakistan.

Material and Methods: 122 consecutive patients ranging in age from 4-12 years presenting in Nishtar Institute of Dentistry and fulfilling the inclusion and exclusion criteria were included in the study. Thorough history, clinical examination, periapical radiographs using standardized methods for children were performed. The whole procedure of pulpotomy was carried out. After achieving hemostasis, pulp stumps were covered with Biodentine™. Children were followed up for clinical and radiographic assessment at 3 months. The clinical success criteria in terms of absence of pain, pathologic mobility, swelling, sinus, pathological root resorption and radiographic success criteria in terms of periapical and furcal radiolucency were noted.

Results: Among 122 pediatric patients, males were 75/122 (61.47%) and females were 47/122 (38.52%). Mean age of the patients was 7.67 ± 1.3 years. The clinical success of Biodentine™ was identified in 117/122 (95.90%) of the patients. Where as radiological success was identified in 115/122 (94.26%) patients.

Conclusion: Biodentine™ as a pulpotomy agent has a high success rate and should be routinely used in practice for the treatment of carious primary molars.

Keywords: Pulpotomy; Biodentine; Formocresol.

INTRODUCTION

It is always a challenge for a dentist to manage a grossly carious primary molar tooth. Therefore, competency in selecting an appropriate restorative material and technique is required by the clinician for treating the deciduous molars.¹

Pulpotomy is a clinical procedure which is performed upon accidental or carious exposure of dental pulp, if a tooth is free of any obvious periradicular pathology. In case of primary teeth, this procedure is indicated for reversible pulpitis or mechanical exposure of pulp.¹ After amputation of coronal tissue, it is assumed that remaining radicular tissue is vital. This tissue should be free of any necrosis and excessive hemorrhage.²

Different materials are used to treat remaining vital radicular pulpal tissue. These clinically successful medicaments include Buckley's Solution of formocresol, ferric sulfate, glutaraldehyde and calcium hydroxide.² Electrosurgery also has demonstrated success. However, since mid 1990s, Mineral Trioxide Aggregate (MTA) has been recognized as the reference material for the conservative pulp vitality treatments such as pulpotomy in temporary teeth. It has shown to stimulate the formation of dentin

bridge protecting the pulp markedly more than that observed with calcium hydroxide.³ Biodentine is the latest development in this class of drugs. This new calcium silicate based material exhibits physical and chemical properties similar to those described for certain Portland cement derivatives.^{4,5} On the biological level, it is perfectly reactionary dentin as it stimulates odontoblast activity and reparative dentin by induction of cell differentiation.⁶ It is in effect a dentin substitute that can be used as a coronal restoration material and can be placed in contact with the pulp. Its faster setting time makes it directly functional intraorally without fear of the material deterioration.^{6,7} Clinical trials show that biodentine performs equal to or better than formocresol, ferric sulfate or MTA and is now considered as the preferred pulpotomy agent for the future.⁸⁻¹¹

The clinical and radiological success rate of Biodentine for pulpotomy are extensively being studied internationally in various ongoing large randomized controlled trials and cohort studies.^{9,10} The published data mostly consists of its beneficial effects at a molecular level.⁴⁻⁶ However, one published study states that Biodentine has success rates similar to that of mineral trioxide aggregate (MTA)¹¹ i.e. 94.7% with additional benefits of faster setting time and better odontoblastic activity. In another study, the reported clinical as well as radiological success rate of biodentine was 95%.¹² However, as this is currently an area of ongoing research and debate, we conducted this study to find out the success rate of this newly emerging pulpotomy agent in our local population too. This will add to our local database, and if its success rate found to be high will enable us to use this material in our patients more confidently.

MATERIAL AND METHODS

After informed consent, 122 study subjects were selected consecutively by following non probability sampling technique for this Quasi experimental study. This study was approved and verified by Institutional Ethical Review Committee of NID, Multan. Patients visiting the Operative Dentistry Department, NID, Multan, fulfilling the inclusion and exclusion criteria were included in this study. The diagnosis of the vital pulps was determined by history, clinical examination, response to thermal and electrical pulp tests, and pre treatment radiographs of the

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How to cite this article: Mobeen Akhtar, Sadiq Amin Ahmed Rana, Muzammil Jamil Ahmed Rana, Naghma Parveen, Muhammad Kashif. Clinical and radiological success rates of biodentine for pulpotomy in children. International Journal of Contemporary Medical Research 2016;3(8):2334-2336.

affected teeth. All the patients were treated with biodentine pulpotomy. Medicaine injection with 1:100,000 epinephrine (Huons Co.Ltd, Korea) was administered as a local anesthetic in all patients. Cotton rolls and suction were used for maintenance of isolation in all patients (in order to standardize procedures), since some children under age 6 years did not tolerate a rubber dam. All caries were removed. Upon pulpal exposure during cavity preparation, the status of the exposure site and the amount and characteristics of bleeding were evaluated. If the bleeding was easily controlled and light red in color, the inflammatory process was assumed to be limited to the coronal pulp. Following this diagnosis, the pulp chamber roof was removed, and the coronal pulp was amputated using a high-speed instrument with a sterile diamond bur and continuous water spray (gentle technique). All remaining pulp tissue was excavated, and the chamber was irrigated with normal saline. Hemorrhaging was controlled by placing a sterile cotton pellet over the radicular pulp stump using light pressure. The pellet was removed within 5 minutes, and the hemorrhaging was re-evaluated. Amputation stumps were covered with biodentine paste (Septodont) for 3 minutes. Then intermediate restorative material paste was placed over the pulp stump, and the teeth were restored with Miracle Mix (GC). All the patients were followed up at 12 weeks to assess for clinical and radiological success / failure. All the data were entered in a specially designed proforma.

STATISTICAL ANALYSIS

SPSS version 20.0 was used to analyze the data. Frequencies and percentages were calculated for the descriptive variables like gender, clinical success, radiological success. Mean \pm S.D were calculated for quantitative variables like age. Effect modifiers like age and gender were controlled through stratification. Chi-Square test was applied to see the effect of these on clinical and radiological success rate. When a P value was found to be ≤ 0.05 , it was considered as significant.

RESULTS

In the present study 122 patients were treated for the pulpotomy with biodentine material. After treatment All patients were assessed clinically and radiologically. In 75 male patients participated with minimum age 4 years to maximum age 11 years. Mean age was 7.06 ± 1.58 . When we applied Chi-Square test to observe the statistical association between gender and treatment success, it was found to be insignificant ($p = 0.52$). All these descriptive statistics are tabulated in the Table-1 and 2. Out of total 75 male patients, 3 patients showed failure when assessed radiologically after 12 weeks. At the same time, among 47 female patients, 4 patients showed the radiological failure. Overall, out of 122 patients, 115 were radiologically successful (Table-3).

DISCUSSION

Although many newer and advanced materials, e.g. MTA, are available in the market for pulpotomy but a longer time of setting, fairly complicated to use and low cost effectiveness, are the few factors which urge the scientists to formulate some more suitable materials. Biodentine has dentin-like mechanical properties, which may be considered a suitable material for clinical indications of dentin-pulp complex regeneration.¹³

In the current study, out of total 75 male patients, 1 patient

	Gender		Statistic
	Male (75)	Female (42)	
Age	Mean	7.0533	
	Std. Deviation	1.57595	
	Minimum	4.00	
	Maximum	11.00	
	Mean	7.6383	
	Std. Deviation	1.59381	
	Minimum	4.00	
	Maximum	12.00	

Table-1: Age and gender distribution of study participants

		Clinical success		Total
		Yes Clinical success	No Clinical success	
Gender	Male	74	1	75
		63.2%	20.0%	61.5%
	Female	43	4	47
		36.8%	80.0%	38.5%
Total		117	5	122
		100.0%	100.0%	100.0%

*p = 0.052

Table-2: Association between gender distribution and clinical success rate

		Radiological success		Total
		Yes radiological success	No radio- logical success	
Gender	Male	72	3	75
		62.6%	42.9%	61.5%
	Female	43	4	47
		37.4%	57.1%	38.5%
Total		115	7	122
		100.0%	100.0%	100.0%

*P = 0.297

Table-3: Association between gender distribution and radiological success rate

showed failure when assessed clinically after 12 weeks. At the same time, among 47 female patients, 4 patients showed the clinical failure. If we see the clinical success rate, it was highly successful, as among 122 patients, 117 were clinically successful.

A study was carried out on intact permanent premolars which were scheduled to be extracted for orthodontic reasons. The researchers electively exposed the pulp of 28 teeth and utilized Biodentine a pulp capping material. These teeth were extracted after six weeks and were stained with hematoxylin and eosin stains. Nowicka et al. found that majority of specimens showing a complete dentinal bridge formation and an absence of inflammatory pulp response. Layers of well-arranged odontoblast and odontoblast-like cells were found to form tubular dentin under the osteodentin. They also found no statistically significant differences between the Biodentine and MTA experimental groups.¹⁴

Another type of MTA (ProRoot) was compared with Biodentine in relation to silicon and calcium uptake in root dentine in a study by Han and Okiji. They observed that elemental uptake was more pronounced in roots treated with Biodentine as compared

to MTA.¹⁵ Laurent *et al.* evaluated its genotoxicity, cytotoxicity, and effects on the target cells' specific functions and found that it did not affect the pulp fibroblast specific functions such as mineralization, as well as expression of collagen I, dentin sialoprotein, and Nestin.¹⁶

Regarding the biological effects of Biodentine on dental pulp, Perard and his colleagues conducted a study, they reported that COL-1A1 expression was slightly lower in cultured spheroids of odontoblasts treated with MTA but it was higher in case of Biodentine. This CO1A1 gene is responsible for matrix formation. Therefore, they were of the opinion that Biodentine is more suitable material for pulp capping as compared to MTA.¹⁷ Similar beneficial effects of Biodentine had been reported by Ville and his coworkers. He demonstrated a rapid tissue response and the formation of a dentinal bridge in the root as well as coronal dentine over a period of 3-6 months after pulp capping with Biodentine. In another study, researchers had reported that blood contamination had no effects on a push out bond strength of Biodentine.^{17,18}

Researchers studied the effect of etching with 35% phosphoric acid as compared to glass ionomer cement and light-cured glass ionomer cement and found that Biodentine exhibited a lower calcium to silicon ratio and a reduction in the chloride peak height when etched.¹⁹ Biodentine performs well without any conditioning treatment as a dentin substitute. Hence, etching of Biodentine is not recommended and it is directly bonded to the resin composite. Use of self etch and total etch systems for bonding Biodentine to resin composites had no significant difference between both and suggested use of both self etch as well as total etch adhesives.²⁰

CONCLUSION

In current study this product (Bidentine) found very effective in terms of clinical and radiological aspect. Biodentine holds promise for clinical dental procedures as a biocompatible and easily handled product with short setting time. Therefore, Biodentine is an interesting alternative to MTA.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 24-06-2016; **Published online:** 25-07-2016