ORIGINAL ARTICLE

A COMPARISON OF THE HUMAN PULPAL PAIN RESPONSE TO BIODENTINE AND MINERAL TRIOXIDE AGGREGATE AS PULP CAPPING AGENT

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ABSTRACT

Biodentine is a calcium-silicate based material that has incited considerable interest in present-day dentistry owing to its resemblance to mineral trioxide aggregate (MTA) and its relevance where MTA is indicated. It has dentin-like mechanical properties, which may be contemplated as an appropriate material for clinical implications of dentin-pulp complex regeneration like pulp capping. The aim of the present study was to compare the human pulpal pain response to Biodentine and MTA as pulp capping agent. Present study was performed on 100 maxillary and mandibular asymptomatic vital permanent molars with extensive caries. Patients were assigned into two groups of fifty each. Patients in group A were pulp capped with Biodentine and patients in group B were pulp capped with MTA. Pain was recorded using Visual Analog Scale after 1, 3 and 6 months follow-up periods. The majority of patients in both the groups presented with lack of pulpal pain response. Statistical analysis using chi-square test (IBM SPSS Version 22) demonstrated no significant difference between both study groups throughout the course of clinical study.

Key Words: *Pulp capping, Biodentine, MTA, Pulpal pain, Visual analog scale.*

INTRODUCTION

The placement of biocompatible materials on pulp injury site defends the pulp-dentin complex against chemical insult by operative procedures, material toxicity and bacterial penetration due to microleakage.[1-3] Calcium Hydroxide (CaOH) has been regarded as a preference material in situations where vital pulp therapy is indicated.[2,5-6] However, CaOH displays partial dentin bridge formation with tunnel defects resulting in pulp capping failure.[2] Mineral Trioxide Aggregate (MTA) has provoked significant attention being a direct pulp capping material in present-day dentistry. MTA was introduced in 1990's in Loma Linda University essentially as root repairing and apical filling material. Afterwards many studies have demonstrated MTA to be a predictable pulp capping material.[3,4] MTA elicits dentinal bridge induction faster than CaOH, resulting in pulpal healing and high success rates in clinical procedures.[2-3,6] MTA is essentially calcium oxide as tricalciumsilicate, dicalcium silicate and tricalcium aluminate. Bismuth oxide is used as a radiopacifier. MTA is a biocompatible, anti-bacterial and radiopaque material with the ability of releasing bioactive dentin matrix proteins and a good sealing capacity.[2-4] Aguilar and Linsuwanont clinically compared the success rate of CaOH and MTA as the pulp capping agent; they established that MTA exhibited a more successful outcome than CaOH.[5] However, MTA still has limitations including tough handling properties, high solubility, prolonged setting time and possible discoloration of dental tissues.[2]

Biodentine (Septodont, Saint Maurdes Fosses, France) is a novel calcium silicate cement, which may be employed as a substitute of dentin resembling MTA. It stimulates tertiary dentin formation on contact with vital pulp cells.[2,7] It is composed of powder and liquid, where powder contains mainly tricalcium silicate, zirconium dioxide as radiopacifier, calcium carbonate as filler, dicalcium silicate (traces), calcium oxide (traces) and iron oxide (traces). The liquid is composed of calcium chloride for faster setting and a hydrosoluble polymer

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as a water reducing agent. It can be applied directly as a bulk dentine substitute without pre-conditioning.[7-10]

Both MTA and Biodentine possess reasonable sealing properties contrary to CaOH. Both the materials differ slightly in composition. Tricalcium and dicalcium silicate are the two chief constituents of both MTA and Biodentine. Biodentine is less radiopaque than MTA, though it is visible on radiograph. MTA's setting time is 2 hours whereas Biodentine sets in 12 minutes. For achieving this decreased setting time of 12 minutes, particle size was controlled along with addition of calcium chloride and water reducing agents plus the filler content of calcium carbonate.[2,6,9] MTA's surface texture is sandy while Biodentine possesses a creamy stone like texture. The physical properties of Biodentine resemble those of dentin and Glass Ionomer. Upon setting both MTA and Biodentine result in formation of CaOH. This CaOH acts as a potent antibacterial agent. The bonding of both MTA and Biodentine to dentine is physicochemical in nature.[10]

METHODOLOGY

Present study was reviewed and authorized by the Ethical Committee of Armed Forces Institute of Dentistry, Rawalpindi. Patients were informed about clinical procedure and possible complications. Informed consent forms were signed by all the patients. This study included 100 patients aged between 19-50 years with eighty subjects in age group of 19-34 years and twenty subjects in age group of 35-50 years. Out of these 100 patients fifty one were males and forty nine were females. The subject teeth were mandibular and maxillary asymptomatic vital permanent first and second molars with extensive caries. Pre-operative radiographs were obtained and teeth were selected with radiographic deep decay in proximity to pulp chamber. Present study excluded Pregnant or Nursing mothers. All patients were assigned randomly into two groups according to Lottery method. In each group after local anesthesia (Septodont Lignocaine HCl 2%, Septodont, France) and rubber dam application, carious lesion was initially excavated by using high-speed round sterile diamond burs (Mani inc, Japan) under air-distilled water cooling and the deeper caries was excavated with slow-speed carbide round burs (No. 2-6) (Mani inc, Japan) until the pulp was encountered. New burs were used during each operation. After pulpal exposure, hemorrhage was controlled with saline irrigation and sterile cotton pellet was placed onto the pulpal exposure site to achieve hemostasis. In group A the pulps of teeth were capped with Biodentine (Septodont, Saint Maur des Fosses, France) as per manufacturer's recommendations and were provisionally restored with GIC (GC Gold Label, Japan). In group B, pulps were capped with a 2mm- thick layer of ProRoot white MTA (Dentsply, Tulsa Dental, Tulsa, OK) as per manufacturer's recommendations. After placing MTA, a damp cotton pellet was laid directly over the material and the cavity was sealed with an interim GIC restoration (GC Gold Label, Japan). After 7 days patients in both groups were recalled for evaluation and permanent restoration. Permanent restorations were done with composite (3M ESPE Filtek, P60). Post-operative pain was recorded by using Visual Analog Scale. The scale was categorized as

1) No pain = 0
2) Mild pain = 1-3
3) Moderate pain = 4-7
4) Severe pain = 8-10

The patients were recalled after 1 month, 3 months and 6 months. Post-operative radiographs were taken on 3 months and 6 months recall visits to detect any apical radiolucency. If the subject perceived any post -operative pain or sensitivity to cold spray then outcome was recorded as failure. Procedure was considered successful when patient had no pain, sensitivity or apical radiolucency at recall visits.

RESULTS

Present study involved 100 subjects aged between 19-50 years. Out of them fifty one were males and forty nine were females. Eighty subjects were in age group of 19-34 years and 20 subjects were in age group of 35-50 years. Out of 100 subject teeth, 54% were mandibular

TABLE 1: PAIN RESPONSE AFTER PULP CAPPING WITH BIODENTINE AND MTA

			Pain after pulp capping		Total
			Yes (%)	No (%)	
Pulp capping material	**Biodentine**	Count	4	46	50
		% within pulp capping material	(8.0%)	(92.0%)	(100.0%)
	MTA	Count	3	47	50
		% within pulp capping material	(6.0%)	(94.0%)	(100.0%)
Total		Count	7	93	100
		% within pulp capping material	(7.0%)	(93.0%)	(100.0%)

TABLE 2: CHI-SQUARE TESTS FOR COMPARISON OF PULPAL PAIN RESPONSE AFTER PULP CAPPING WITH BIODENTINE AND MTA

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.154[a]	1	.695		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.154	1	.695		.500
Fisher's Exact Test				100	
Linear-by-Linear Association	.152	1	.697		
N of Valid Cases	100				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.50.

b. Computed only for a 2x2 table

TABLE: 3 PAIN RESPONSE IN AGE GROUPS AFTER PULP CAPPING WITH BIODENTINE AND MTA

			Pain after pulp capping		Total
			Yes (%)	No (%)	
Age groups	**Age group 19-34 years**	Count	5	75	80
		% within age groups	(6.3%)	(93.8%)	(100.0%)
	Age group 35-50 years	Count	2	18	20
		% within age groups	(10.0%)	(90.0%)	(100.0%)
Total		Count	7	93	100
		% within age groups	(7.0%)	(93.0%)	(100.0%)

TABLE 4: PAIN RESPONSE IN GENDER GROUPS AFTER PULP CAPPING WITH BIODENTINE AND MTA

			Pain after pulp capping		Total
			Yes (%)	No (%)	
Gender	**Male**	Count	4	47	51
		% within Gender	(7.8%)	(92.2%)	(100.0%)
	Female	Count	3	46	49
		% within Gender	(6.1%)	(93.9%)	(100.0%)
Total		Count	7	93	100
		% within Gender	(7.0%)	(93.0%)	(100.0%)

first molars, 16% were maxillary first molars, 26% were mandibular second molars and 4% were maxillary second molars. The patients' gender and tooth type ratings were not significantly different between the Biodentine and MTA groups.

After treatment seven patients, four in Biodentine group (group A) and 3 in MTA group (group B), complained of mild pain on the first day of pulp capping. All of the remaining patients were asymptomatic with normal cold test. In addition, no periapical pathologies were revealed by radiography before the clinical procedure and after the experimental time period (Table 1). Chi-square test (IBM, SPSS, and Statistics Version 22) was used to compare the two groups. P value < 0.05 was considered significant. In present study P value for Biodentine group and MTA group were >0.05 which means that Biodentine and MTA do not have any significant difference as a pulp capping agent (Table 2).

DISCUSSION

This study was aimed at comparing the effectiveness of Biodentine and MTA as a pulp capping agent. In 15-34 years age group, 5 patients presented with pain which can be explained due to an increased cellular content, comparatively larger pulp space , an abundant blood supply and there upon a rapid inflammatory response

and poor localization of infection in young individuals. Only 2 patients in 35-50 years age group presented with pain because with advancing age, a reduction in pulp chamber volume and relative constriction of occluso-gingival reduction occurs due to an increased secondary and reparative dentin formation. The pulp horns and root canals also reduce in volume. With this ongoing reduction in size of the pulp, the inherent risk of pulpal exposure and there upon pain tends to decrease with the age of the patient.[5]

Biodentine is a tricalcium silicate cement resembling MTA as both can provoke secretion of reactionary dentine restoring pulpal health.[4] Nowicka A et al conducted a clinical study to compare the response of pulp-dentin complex in 28 permanent molars after pulp capping with Biodentine and MTA and similar to present study found no significant difference in pulpal pain response between Biodentine and MTA groups during 6 weeks experimental period. They concluded that Biodentine had similar efficacy in the clinical setting and may be regarded as an interesting alternative to MTA in pulp capping procedure.[2] Gupta A et al in his study concluded that Biodentine is a promising material which has the potential to maintain pulp vitality in patients judiciously selected for direct pulp capping. The single stage approach in pulp capping simplifies and improves the clinical use of Biodentine.[11]

In present study, it is apparent that asymptomatic teeth (without signs of pulpitis) will retain their vitality and lack any post-operative pain regardless if Biodentine or MTA is used. However, true interpretation of the success of pulp capping materials is achievable by histological studies.

CONCLUSION

Biodentine demonstrated a comparable effectiveness similar to MTA and may be regarded as a viable and predictable pulp capping material in an effort to maintain the vitality of pulp.

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