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Biodentine: the new bioactive and biocompatible material of choice for direct pulp capping & Pulpotomy in curiously exposed permanent teeth: case reports

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Abstract
Direct pulp capping with Biodentine over a carious exposure in a mature permanent tooth may be a reasonable alternative to root canal therapy or extraction. Biodentine is an interesting alternative to calcium hydroxide. It offers advantages like easy to manipulate, shorter setting time & relatively inexpensive and in properly selected cases may contribute to the long-term maintenance of tooth vitality. It has a positive effect on vital pulp cells and stimulates tertiary dentin formation. In direct contact with vital pulp tissue, it also promotes the formation of reparative dentin. The present article concludes Biodentine is an interesting and promising material which has the potential to maintain pulp vitality in patients judiciously selected for direct pulp capping.

Keywords: Biodentine, Direct Pulp Capping, Reversible pulpitis, Reparative Dentin, bioactive, biocompatible

Introduction
Vital pulp therapy is indicated mainly in those teeth which have traumatic or accidental exposure regardless of open or closed apex. Pulp is equipped with a barrier system to shield the teeth from bacterial intrusion so it is valuable to preserve the vitality of an exposed pulp by using vital pulp therapy favorable outcome of a vital pulp therapy depends on good knowledge of pulp anatomy, biocompatible material and using sterile technique [1]. Cveks partial Pulpotomy consists of removal of inflamed pulp tissue beneath an exposure to a depth of 1-3mm, use of bactericidal irrigants to control hemorrhage, placement of a biocompatible material to promote healing and maintain vitality of the remaining pulp tissue. In those cases in which the pulp exposure is extensive is not recommended. Calcium hydroxide became recognized as a valuable Pulpotomy material but has several disadvantages. It may get neutralized by tissue fluid prior to its action on the bacterial cells and loses its antibacterial activity due to decrease in its acidic pH. Bacterial toxins can readily penetrate the permeable hard-tissue bridge that formed in response to the calcium hydroxide and can cause serious pulpal damage. Various pulp capping agents are recently available. Abedi *et al.* [2]. In 1996 reported use of mineral trioxide aggregate (MTA) as a successful agent for pulp capping. It includes several advantages such as biocompatibility, hydrophilic nature and close adaption to dentin-preventing bacterial leakage. MTA also has some drawbacks such as a long setting time, high cost, and potential of discoloration so a new bioactive cement came into picture and it has several advantages which includes good sealing ability, adequate compressive strength, and short setting time [3, 4]. The following case reports describe the technique of Biodentine Pulpotomy in mature permanent teeth following carious pulpal exposure. Biodentine is one of the recently developed Tricalcium silicate-based materials and could be used for deep and wide coronal tooth decay, restoration of the deep cervical and root lesions, in direct pulp capping, repair of the root perforations, and as a root-end filling material. [5] The most important advantages of Biodentine over MTA are it could be easily manipulated as a result of its higher viscosity and its much shorter setting time. [6] These features make Biodentine a suitable direct pulp-capping material.

Case Description

A 21 year old female patient reported to the department of conservative dentistry & endodontics with chief complaint of pain on consuming hot and cold food stuff only when it was in contact with the exposed tooth in lower left back region of jaw. History revealed that patient experienced transient pain on having cold beverages which was relieved once the stimulus was removed. On clinical examination a occlusal carious lesion was found with 46. The procedure of was explained to the patient and an informed consent was taken. Right mandibular tooth was anesthetized using 0.6ml lignocaine (1:200,000 adrenaline) and teeth were disinfected with chlorhexidine. The superficial layer of the exposed pulp and the surrounding tissue were excised to a depth of 2 mm using a high-speed no. 2 round diamond bur along with a water coolant. The bleeding from the radicular pulp signified healthy status of the pulp. The surface of the remaining pulp was irrigated with isotonic saline along with gentle application of small sterile cotton pellets for 5 minutes until the bleeding was arrested. Freshly mixed Biodentine™ (Rue du Pont de Créteil, 94100 Saint-Maur-des-Fossés, France) was immediately placed over the exposed pulp, following which it was allowed to set for 20 minutes and then sealed with restoration. (FIG1). Periodic follow-ups were carried out at 24 hours; 1 week; 30 days; 3, 6 & 12 months (FIG 2). The following was checked: Tenderness to percussion, swelling and pain. Electric pulp testing was done after a period of time & Radiographic examination to check for evidence of any root resorption or widening of the periodontal ligament space.

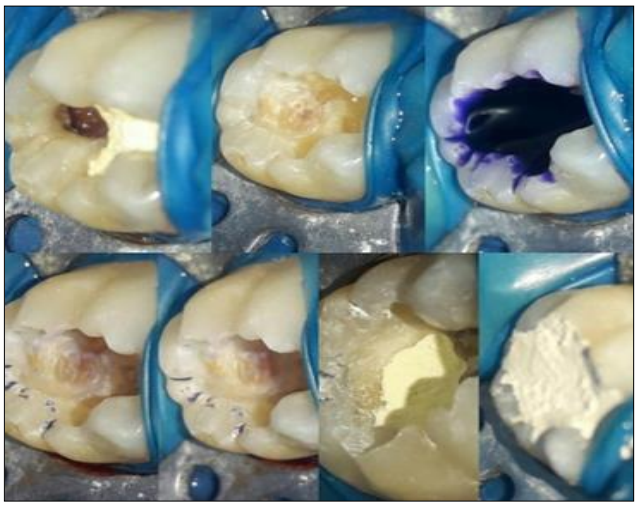

Fig 1: Preoperative Caries, Caries removed, Biodentine placed and then restored with Restoration

Fig 2: Biodentine Placed

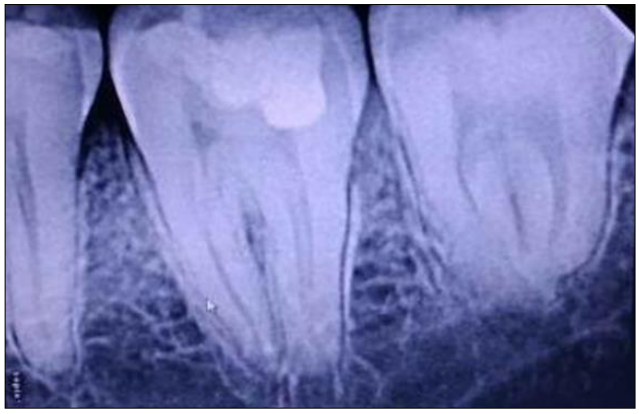

Fig3: Follow-up radiograph after 1 year, patient was completely asymptomatic

Discussion

Pulp integrity of the tooth should be maintained for long term survival, to retain the tooth as functional unit and to withstand heavy masticatory forces [4, 5, 7]. In 1920, a new era in the treatment of exposed pulp began when Hermann introduced Calcium Hydroxide that induced the bridging of the exposed pulp with reparative dentin [5]. Both clinically and histologically it has been found to produce satisfactory results in indirect and direct pulp capping. For many decades calcium hydroxide formulations are the best documented and most reliable materials for direct pulp capping and serve as the "gold standard". Nevertheless, calcium hydroxide has some drawbacks like tunnel defect during dentinal bridge formation, poor bonding to dentin, material resorption and mechanical instability. The high pH (12.5) of calcium hydroxide suspensions causes liquefaction necrosis at the surface of the pulp tissue. Various competitive substitutes have been introduced in restorative dentistry, out of which Biodentine, a bioactive cement is comparatively better than others. Factors which influence treatment decisions when encountering teeth with pulp exposure include the degree of infection and inflammation of the pulp rather than the size or duration of pulp exposure. Carious process can lead to marked changes within the pulp-dentin complex which can vary considerably depending on the severity of the disease and the age of the pulp. It is generally agreed that larger carious exposures have a poor prognosis due to a more severely inflamed pulp, risk of necrosis and bacterial contamination. Careful case selection and treatment planning is critical for better outcome of treatment rendered. Abarajithan *et al* [7]. Found a normal response to electric pulp test as well as custom-made pulse oximeter and absence of periapical pathology in two cases of traumatic pulp exposures treated with Pulpotomy using MTA at the end of 2 years. Subay *et al* [8]. Followed up six immature teeth with gray MTA pulpotomies after traumatic and mechanical pulp exposures and found two cases unsuccessful, and severe discoloration in all six cases. Drawbacks such as the prolonged setting time, difficult handling characteristics, and high cost of MTA have created a need for search of a more suitable material. Biodentine has dentin-like mechanical properties, which may be considered a suitable material for clinical indications of dentin-pulp complex regeneration Nowicka *et al* [9]. Studied the response of Biodentine direct pulp-capping in 28 caries-free maxillary and mandibular permanent intact human molars scheduled for extraction for orthodontic reasons after mechanical exposure. After 6 weeks, the teeth were extracted, stained with hematoxylin-eosin. They found 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. Han and Okiji [10] compared Biodentine and white ProRoot MTA in terms of Ca and Si uptake by adjacent root canal dentine and observed while both materials formed tag-like structures, dentine element uptake was more prominent for Biodentine than MTA. The same authors in another study showed higher calcium release for Biodentine as compared with MTA. The tag-like structures formed were composed of Ca and P-rich and Si-poor materials. Pérard M *et al* [11]. Assessed the biological effects of Biodentine for use in pulp-capping treatment, on pseudo-odontoblastic and pulp cells. They also evaluated the effects of Biodentine and MTA on gene expression in cultured spheroids, and found that Col1a1 expression levels were slightly lower in cells cultured in the presence of MTA than in those cultured in the presence of Biodentine and in control cells. They concluded that both MTA as well as Biodentine are suitable for pulp-capping. Villat C *et al* [12]. Performed partial Pulpotomy using Biodentine in an immature second right mandibular premolar and demonstrated a fast tissue response both at the pulpal and root dentin level with formation of a radio-opaque bridge within 3-6 months. They suggested the use of Tricalcium silicate cement should be considered as a conservative intervention in the treatment of symptomatic immature teeth. Biodentine had significantly higher push-out bond strength than MTA after 24 hours setting time. After 7 days, MTA and Biodentine had similar push-out bond strength in uncontaminated samples. Blood contamination had no effect on the push-out bond strength of Biodentine, irrespective of the duration of setting time.

In the current four cases, there was no history of spontaneous pain, sensitivity to cold be short-lived, electric pulp test demonstrated a vital tooth, and radiographs did not show any evidence of root fracture or apical lesion. These signs and symptoms indicate a vital pulp which is worthy of preservation. Color and consistent bleeding of the pulp were seen to be important factors observed during the treatment. In all our cases, hemostasis was achieved within 5 minutes signifying a healthy pulp.

Biodentine (Septodont, Saint Maur des Fosses, France) was used for the pulp-capping procedures because its good sealing ability, short setting time, biocompatibility, bioactivity, and bio mineralization properties and was a better option than MTA for a single sitting Pulpotomy procedure. Biodentine is mechanically stronger, less soluble, and gives a tighter seal. Biodentine shares both its indications and mode of action with calcium hydroxide, but does not have its disadvantages. Three major disadvantages of calcium hydroxide, higher material resorption rate, mechanical instability, and failure to prevent microleakages are therefore avoided. Biodentine is mechanically stronger, less soluble, and gives a tighter seal. Compared to other materials such as MTA, Biodentine handles easily and needs much less time for setting. [5] Hence, in this study; Biodentine had a significantly more pronounced antibacterial effect than MTA. The antimicrobial action of MTA is attributed to its high initial pH of 10.2, which rises to 12.5 in 3 h. Biodentine handles easily and needs much less time for setting. The powder mainly contains Tricalcium and di-calcium silicate as well as calcium carbonate. The liquid consists of calcium chloride in aqueous solution with an admixture of Polycarboxylate, which sets in 12 min.

In both cases, a distinct radio-opaque barrier formation is seen suggesting a dentin bridge formation. Also, all the concerned the teeth gave a vital response to electric pulp test, remained asymptomatic, and did not develop any apical Pathoses. We can safely conclude that 18 months post-operative evaluation is sufficient to demonstrate any possible failures in the present cases.

Camilleri J [13]. 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 lower calcium to silicon ratio and a reduction in the chloride peak height when etched. An in vitro study by Raskin A *et al* [14]. Found that 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 were studied by Hashem *et al* [15]. Who found no significant difference between both and suggested use of both self-etch as well as total etch adhesives. Odabaş *et al* [16]. compared the shear bond strength of different adhesive systems to Biodentine and found no statistically significant difference between 1 step self-etch, 2 steps self-etch adhesives, & etch & rinse adhesive systems We used a total etch adhesive system for bonding resin composite to Biodentine, but single or two step self-etch adhesive can also be used. Biodentine is an interesting and promising material which has the potential to maintain pulp vitality in patients judiciously selected for direct pulp capping.

Conclusion

The teeth in which direct pulp capping was carried out were asymptomatic and did not develop any tenderness to percussion. Electric pulp testing revealed vital response at the end of 18 months. Radiographic examination revealed absence of periapical lesion or widening. In both cases a well-defined radio-opaque layer formation was seen on the pulpal aspect adjacent to the layer of Biodentine suggestive of a calcific barrier. Cveks Pulpotomy can be considered a viable treatment option in such cases.

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