Mini Review

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Contemporary Trends in Conservative Management of Pulp in Primary and Permanent Teeth

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ABSTRACT

This manuscript previews the introduction of significant advances in the materials which are used in the conservative management of pulp in the primary and permanent teeth. These materials posses the property of inducing tertiary dentin formation and the protection of the dentin-pulp complex. Calcium Hydroxide, Mineral Trioxide Aggregate (MTA), Biodentine are widely used and are discussed along with some of the recently introduced materials. The primary aim of this article is to outline the emerging concepts and their associated advantages.

Keywords: Indirect Pulp Capping; Indirect Pulp Therapy; Calcium Hydroxide; Mineral Trioxide Aggregate; Biodentine; Primary Teeth; Permanent Teeth

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One of the primary goals of conservative management of pulp is to conserve the resiliency of the teeth and maintain the vitality of the supporting tissues. It is essential to preserve these teeth as there may be unfavorable consequences due to their premature loss. To maintain normal function, prolonged retention of a permanent tooth with a root which has favourable crown/ root ratio along with thick dentinal walls is required [1]. Hence, the preservation of the pulp is one of the primary goal in the treatment plan and is an important factor in normal exfoliation of a primary tooth which has its own sequelae on the succedaneous erupting teeth. The type of pulp therapy used, its indications and the objectives depend on the health of the pulp tissue. The following procedures which are being used to provide vital pulp therapy for primary and permanent teeth which are diagnosed with normal pulp or reversible pulpitis are Indirect Pulp Therapy and Indirect Pulp capping [2]. According to the American Academy of Pediatric Dentistry, ''Indirect Pulp Treatment is a procedure performed in a tooth with a deep caries lesion approximating the pulp but without evidence of radicular pathology. Indirect pulp treatment is a procedure that leaves the deepest caries adjacent to the pulp undisturbed in an effort to avoid a pulp exposure. This caries-affected dentin is covered with a biocompatible material to produce a biological seal'' [3].

In Indirect Pulp Capping, the deepest caries is left behind and following which a pulp capping material for example calcium hydroxide is a used as a liner or a base followed by a suitable permanent restorative material for example MTA and Biodentine [1]. Indirect pulp treatment is based on the principle of partial caries excavation, al-

lowing even infected dentin to remineralize. This is mediated by the placement of biocompatible materials such as MTA & Biodentine. The evolution of newer materials and the better understanding of caries process has led to a shift in the paradigm enabling the conservative management of vital pulp in primary and permanent teeth [4]. A lot of materials have been hence developed over the years with their own pros and cons. These material are enlisted in Table 1. Following are the materials used in indirect pulp therapy:

Calcium Hydroxide

One of the gold standard material 'calcium hydroxide' being the oldest material in the treatment of the indirect capping & treatment is still being preferred by many clinicians. It is a highly alkaline white crystalline soluble salt. They are also known among the clinician for their antimicrobial properties and the ability to induce the formation of hard tissue. One of the major properties of calcium hydroxide is the formation of a dent in bridge when they are placed in contact with pulpal tissue. However, this barrier created by the dentin bridge is not always complete [5], hence the biological seal is compromised which may lead to microleakage. The common calcium hydroxide agents used are Dycal, pulpdent etc.

Mineral Trioxide Aggregate

One of the abilities that MTA demonstrates is that it induces hard tissue formation in pulp and as well promotes rapid cell growth. Ford et al [6] stated that the tricalcium oxide in MTA forms calcium hydroxide on reacting with tissue liquids. Farsi et al [7] has also shown a high success rate in pulp capping. It has also been proven to induce mineralisation of the exposed pulp and it has the potential of maintaining pulp vitality and hence, it has known to be a superior substitute for calcium hydroxide in clinical application [8]. Due to certain limitation various newer alternatives of MTA were developed such as ProRoot MTA (1999), MTA angelus, RetroMTA.

Biodentine

Biodentine is a new bioactive cement which has dentin like mechanical property that has a positive effect on the pulp tissue as it stimulates tertiary dentin formation and has a high bonding strength. It also possesses a strong anti-bacterial action. The disadvantage of this material is that it is expensive and cannot be used in root caries [9].

4-META Adhesive

In order to overcome this limitation of calcium hydroxide. 4-META adhesive is introduced which gets absorbed into the pulp and polymerised there resulting in the formation of a hybrid layer with pulp thus providing an adequate seal [10].

TheraCal LC

It is a calcium silicate filled base liner modified with light cured resin. It is used for indirect pulp treatment. Its advantages is that it has high ability to release calcium ions and stimulate hard tissue formation, it is also effective against S. mutans and has improved physical properties as calcium hydroxide. Its compressive strength is greatest when compared with MTA and Biodentin [9].

2% Chlorhexdine Gluconate with Resin Modified GIC or Calcium Hydroxide

AAPD published an article stating that when IPT was performed using 2%CHX with RMGIC in primary molars the success rate of indirect pulp treatment was shown to be successful [11,12].

Lasers

As microleakage was commonly encountered in a deep lesion, due to bacterial infiltration a newer concept of using lasers was implemented. For the removal of these large restorations, electric drills at low speed can be used. It causes less thermal damage and is less traumatic to the tooth. It also shows reduced inflammation and pain. Lasers can also be used for secondary dentin formation as studied by Yasuda Y, et al. [13].

Resin Modified Glass Ionomer

When placed in close approximation to the pulp, glass ionomer provides potent resistance against bacteria & it also possess good biocompatibility, astounding bacterial seal. The formation of dentin bridge is not as prominent and also it is known to be more toxic as compared to traditional GIC [14].

Direct Bonding Agents

They form a film which can be layered over the exposure site, and it penetrates the dentin without affecting the pulp tissue, it forms an effective barrier against microorganisms, oral fluids etc. The con is that it does not produce calcific bridges. Some investigations have also shown that when the adhesive resin is directly placed on the part of the exposed pulp causes chronic inflammatory response [14].

Bone Morphogenic Protein

They replicate into bone forming cells by producing adult stem cells. Studies stated that the demineralised dentin also has such properties which forms both bone and dentin [14].

Corticosteroid and Antibiotics

Cleocin, neomycin, penicillin, keflin, vancomycin when combined with calcium hydroxide can be used to reduce pulpal inflammation. But it cannot be used in patients who are susceptible to bacteraemia [15-17].

Enzymes

Various enzymes are available which are used as capping material which includes heme oxygenase 1, emdogain, propolis, novel end-

odontic cement. Stem cells have the potential to form tertiary dentin dentin which plays an important role in indirect pulp capping. The disadvantage of stem cells are that the long term effect of such interferences are unknown. Another enzyme propolis is a resinous honey bee product and it is known for its anti-inflammatory and anti-bacterial properties. Emdogain promotes reparative dentin formation, and it is disadvantageous because of its poor sealing quality [9] (Tables 1 & 2).

Table 1: The table contains different materials used in indirect pulp treatment and Indirect pulp capping with their timeline of their introduction.

Material	Timeline
Calcium Hydroxide	1920's [14]
Mineral trioxide aggregate ProRoot MTA MTA angelus RetroMTA	1999[8] 2001 2014
Biodentine	2011[8]
TheraCal LC	2011[8]
Laser	1985-1987[14]

Table 2: Table contains different materials used in indirect pulp treatment & indirect pulp capping with their success rate [8].

MATERIAL	SUCCESS RATE
Calcium Hydroxide	94%
Mineral trioxide aggregate	100%
Biodentine	98.3%
TheraCal LC	87.8%
Resin modified GIC or calcium hydroxide with chlorhexidine	97%
Resin modified GIC	96.5%

Clinical Protocol in Permanent Teeth: Reported Case

A 13-year-old female patient reported in the out-patient department of Pediatric and Preventive Dentistry with the chief complaint of pain in the lower left back region of jaw since a week on food lodgment. The onset of pain was provoked with no history of nocturnal pain and swelling. On clinical examination, tooth 36 was reported with occlusal caries with no pain on percussion, absence of dentoalveolar abscess and normal mobility (Figure 1). On radiographic examination, a deep carious lesion involving enamel, dentin and approaching pulp was identified with respect to 36 (Figure 2). The treatment was carried out under lignocaine (2%) followed by rubber dam application. Partial caries excavation was done using airotor handpiece. Caries was completely removed from the peripheral walls (figure 3). A cotton pellet dipped in sodium hypochlorite solution was placed on the floor of the cavity for 5 minutes (Figure 4). After 5 minutes the cotton pellet was removed, and the soft carious lesion was excavated leaving behind the hard dentin (Figure 5). Biodentine was placed on the floor of the cavity followed by permanent restoration with Resin Modified Glass Ionomer Cement (RMGIC) (Figures 6- 8). The patient was recalled after 3 weeks. The patient came after two and a half months for follow up with no complaints with respect to 36. Stainless steel crown was cemented with respect to 36 (Figures 9-11). Patient is on follow up.

Figure 1: Occlusal caries with food lodgement w.r.t 36.

Figure 2: Radiolucency involving enamel, dentin and approaching pulp.

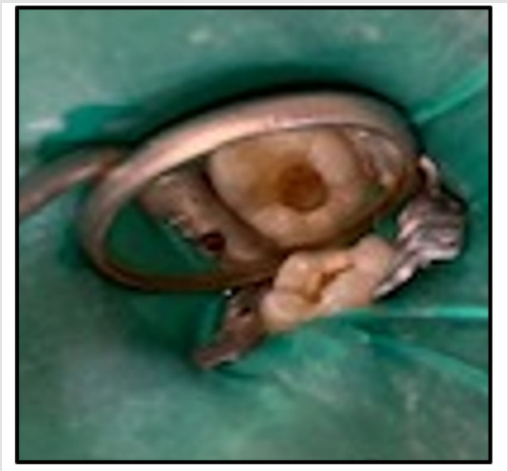

Figure 3: Partial excavation of caries.

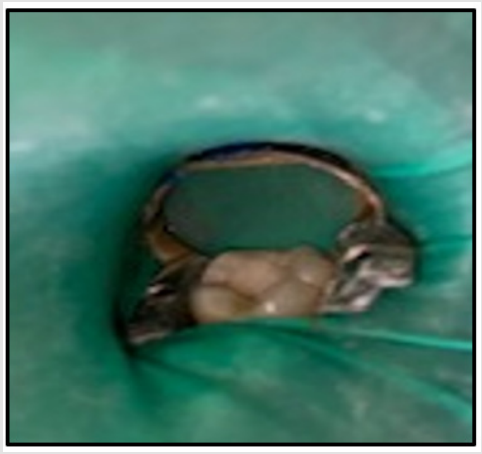

Figure 4: Placement of cotton pellet dipped in sodium hypochlorite solution.

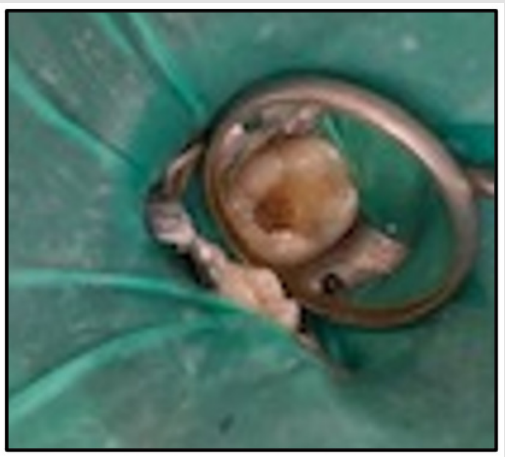

Figure 5: Removal of caries using spoon excavator.

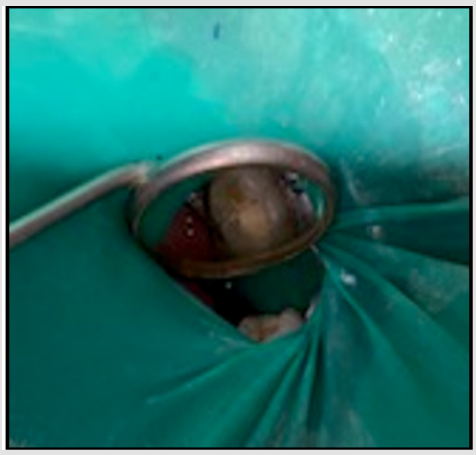

Figure 6: Placement of biodentine on the floor of the cavity.

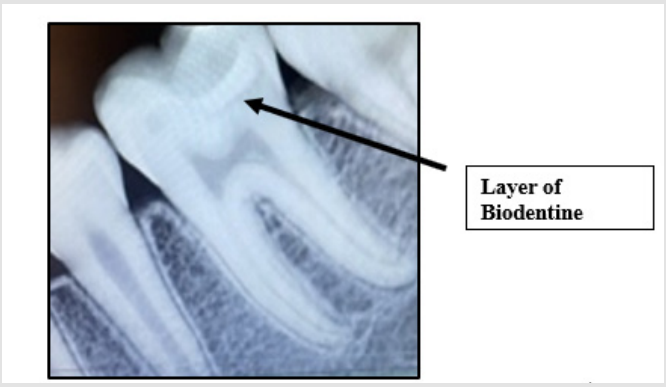

Figure 7: Radiographic appearance of biodentine as radiopacity on the floor.

Figure 8: Resin modified glass ionomer cement restoration with 36.

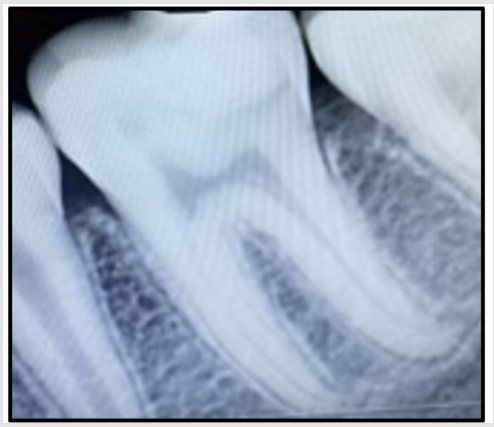

Figure 9: Permanent restoration seen as radiopacity w.r.t. 36.

Figure 10: Stainless Steel crown cementation with 36.

Figure 11: Placement of Prefabricated Stainless Steel crown after 2 months follow.

Conclusion

Based on the selection of the case and the success rates of the material mentioned in Table 2 gives the clinician the choice to select the material which provides adequate sealing and conservative management of the pulp. Hence it is essential to carry out further studies on these materials with randomized controlled trials for the increased success of conservative pulp therapy. The conservative treatment options when carefully considered planned and executed can significantly improve the prognosis and overall clinical life of the tooth. In an oral cavity understanding that most of the teeth affecting pulp in younger generation are the first permanent molars, their vitality, health and stability in maintaing occlusion and oral health cannot be ignored. Thus, careful case selection, aseptic treatment process, robust treatment protocol and extended follow-up are key factors in success of these treatments.

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