International Scientific Peer Reviewed Journals

Vivid Journal of Dental Sciences

Article Id: 2018090001

*Corresponding author
Sathya Reshmi, Department of Pedodontics and Preventive dentistry, Tamilnadu Government Dental College and Hospital, Chennai, India.

Article Information
Received date: Sep 06, 2018
Accepted date: Sep 18, 2018
Published date: Sep 26, 2018

Keywords
Apexification; Biodentine; Calcium hydroxide; Immature tooth.

Case Report

Endodontic Management of Immature Non-vital Permanent Teeth with Two Apexification Materials

Revathy Viswanathan, Abharna Raghunathan, Sathya Reshmi*, Suganthi and Janak Harish Kumar

Department of Pedodontics, Tamilnadu Government Dental College and Hospital, India

Abstract

Immature teeth with open apices and pulpal necrosis are very difficult to treat due to the absence of an apical barrier. The method of inducing the formation of this apical barrier is called apexification. Calcium hydroxide has been the gold standard material for apexification. Due to certain limiting factors, other materials like Mineral Trioxide Aggregate (MTA), collagen etc. were being used. Recently, single visit apexification using a calcium silicate based material – Bio-dentine has become popular. This article is about a case which presented with immature non-vital upper central incisors with open apices. Treatment plan consisting of calcium hydroxide apexification in both the teeth was framed. Progressive results showed apex closure in one tooth, but not in the other. Owing to the repeated visits required for calcium hydroxide apexification and poor patient compliance, single visit Bio-dentine apexification was done in the other tooth and it showed superior results.

Background

Apical closure with complete development of the tooth root takes place for a period of three years following the tooth eruption in a permanent tooth [1]. When teeth are subjected to trauma, caries, pulpal and periapical pathosis during this phase, the root ceases to develop and the resulting apical foramen remains wide open due to interrupted dentine formation. Treatment of these immature non vital permanent teeth with open apices pose a great challenge. These teeth do not have an apical stop, thereby causing extrusion of materials beyond the apex. The resulting root canals also have thin walls which are fragile. Instrumentation would be possible only with an apical barrier enhancing the treatment prognosis.

Apexification is the treatment of choice in these situations. It is a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp [2].

Although several materials have been put forth for this technique, calcium hydroxide has always been the gold standard. But this time-tested material has got its own drawbacks including increased solubility, increased setting time, requires multiple visits, tooth brittleness, etc. Other materials which have been used for apexification are freeze dried dentin, tri-calcium phosphate, protoplast, Mineral Trioxide Aggregate (MTA), collagen calcium phosphate, freeze dried bone, etc. Recently, in 2009 a novel calcium silicate-based material called bio-dentine (Septodont, Saint-Maur-des-Fosses, France) was introduced [3]. It has got many applications like pulpotomy, direct and indirect pulp capping, root resorption and perforation, apexification, dentin substitute and furcation repair. This material is available in powder and liquid form. It has got great manipulative advantages, better biocompatibility, shorter setting time and affordable cost when compared to MTA. These benefits outweigh the disadvantages of calcium hydroxide thus serving as the ultimate alternative. The case report below enlightens the supremacy of bio-dentine over calcium hydroxide.

Case Presentation

A ten-year-old male child reported to the Department of Pediatric and Preventive Dentistry

Citation: Revathy V, Abharna R, Sathya R, Suganthi, Janak HK. Endodontic Management of Immature Non-vital Permanent Teeth with Two Apexification Materials. Viv J Dent Sci. 2018; 1: 2018090001.

with the chief complaint of discoloured and broken upper front teeth. History revealed that the child had a traumatic injury to the upper front teeth six months back. There was no relevant past medical or dental history. On clinical examination, fracture involving enamel, dentin and pulp was observed in the right and left upper permanent central incisors (11,21). Radiographic evaluation using Intraoral Periapical Radiograph (IOPAR) revealed open apices in relation to 11 and 21. On correlating clinical and radiographic examinations, the case was diagnosed as Ellis class 4 fracture in 11 and 21 with immature open apices.

A treatment plan consisting of calcium hydroxide apexification followed by jacket crown insertion in 11 and 21 was framed. During the first visit, access was gained in 11 and 21 following which complete debridement and extirpation of non-vital pulp was done. Working length was determined to be 21 mm and conventional biomechanical preparation was done. Canals were irrigated using chlorhexidine and normal saline and completely dried using paper points (Dentsply, maillefer). For the complete disinfection of the canals, Triple Antibiotic Paste (TAP) consisting of ciprofloxacin, metronidazole and doxycycline in the ratio of 1:1:1 was mixed with normal saline and packed into the canals. When the patient was recalled after ten days he was asymptomatic and hence calcium hydroxide apexification was planned in 11 and 21.

Figure 1: Clinical photograph showing Ellis Class 4 fracture in 11 & 21.

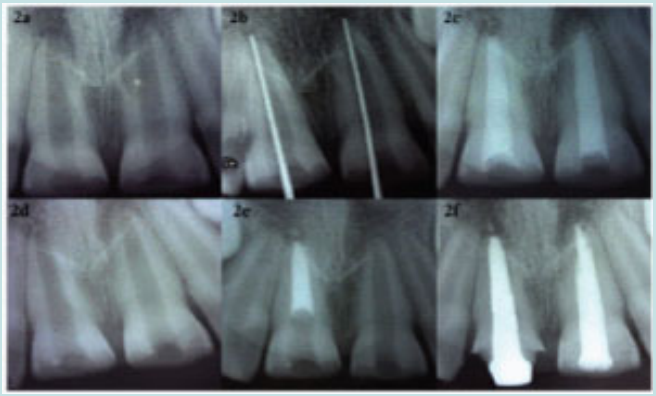

Figure 2a: IOPAR showing immature 11 & 21 with open apices.
Figure 2b: IOPAR showing working length determination.
Figure 2c: IOPAR showing calcium hydroxide apexification in 11 & 21.
Figure 2d: IOPAR showing apex closure in 21 and persisting open apex in 11.
Figure 2e: IOPAR showing Biodentine apexification in 11.
Figure 2f: IOPAR showing obturated 11 & 21.

TAP was flushed out with saline and the canals were thoroughly dried. Subsequently the canals were packed with calcium hydroxide and saline mixture to the entire working length. Finally, orifices were sealed temporarily with glass ionomer cement.

Patient was recalled after three months for review. Radiographic evaluation revealed no signs of apical closure in 11 and 21. Since there was no evidence of apex closure in 11 and 21, patient was kept under observation and to report after three months.

Review at the end of six months revealed radiographic evidence of apex closure in 21 but not in 11. Owing to the inability of the patient to report for further visits, calcium hydroxide apexification was dropped and single visit apexification using Bio-dentine (Septodont, Saint-Maur-des-Fosses, France) was adopted.

Calcium hydroxide was flushed out of the canal in 11 and was completely dried. Bio-dentine was manipulated as per manufacturer's instructions. This mixture was condensed using hand plugger to form an apical plug of 5 mm in 11. Patient was made to wait for about 30 minutes to allow the material to set. After 30 minutes complete set of the material was ensured using Gutta Percha (GP) points. Following this both the canals were obturated using conventional GP points (2% taper, diadent). Orifices were restored with composite resins (Ceram X Duo Dentsply, DeTrey). Patient was recalled after ten days for jacket crown insertion in 11 and 21.

Figure 3: Crown rehabilitation with acrylic jacket crowns in 11 & 21.

Discussion

Treating a non-vital young permanent tooth with open apex is considered a great challenge. Proper radiographic and clinical assessment of such teeth is very important for treatment planning. These cases are an ideal indication for the procedure of apexification [4]. The goal of apexification is to obtain an apical barrier to prevent toxins and microbes from entering the root canal and to confine the obturating material within the root canal favouring repair of periapical tissue [5].

A number of materials have been used for apexification of which calcium hydroxide has been a time tested one. Calcium hydroxide can

induce healing because of its antibacterial activity. Due to its high pH, the highly reactive OH- ions produce damage to bacterial cytoplasmic membrane, by denaturing proteins, destroying lipoproteins, phospholipids and unsaturated fatty acids. Calcium hydroxide hydrolyses the bacterial endotoxins and causes inactivation of inflammatory reaction and bone resorption at the periapex [6]. The alkaline environment neutralises lactic acid from osteoclasts, preventing dissolution of dentin.

Ca^{2+} can release collagen type 1, osteopontin, osteocalcin and alkaline phosphatase in osteoblast. It can also induce mineralisation and release phosphate ions into blood stream that reacts with Ca^{2+} to form calcium phosphate of hydroxyapatite [7].

Calcium hydroxide also induces expression of a growth factor BMP-2 that helps regeneration of bone, cementum, periodontal tissue, thereby helping in calcific barrier formation [8].

Calcium hydroxide has been proven to be a successful material for apexification (74-100%) by Sheehy and Roberts [5]. Though the success rate is high, certain inherent disadvantages discourage the clinicians from using it for apexification. These include the unpredictability, lengthy procedure, temporary coronal restoration, high chances of re-infection, frequent instrumentation to renew the material making the tooth vulnerable to root fracture [9]. To avoid these, certain authors have proposed the single visit apexification using MTA.

MTA was introduced by Torabinajed and colleagues at Loma Linda University [10]. It is a tri-calcium silicate-based cement. Pro Root MTA (Dentsply, Johnson City, TN, USA) was the first new generation biomaterial available commercially [11]. According to their concept, an apical plug of 5 mm of MTA packed into the canal provided tight seal. MTA is osteoconductive, biocompatible with good sealing ability and hydrophilic [12]. Shortcomings of MTA include prolonged setting time (2hrs 45mins -3hrs), technique sensitivity, difficult compaction and nonbonding to tooth and prohibitive cost.

Biodentine is a new bioactive dentin substitute based on Active Bio-silicate Technology introduced by Septodont in September 2010. It is available as powder and liquid. The powder consists of Tri-calcium silicate (the main core), Di-calcium silicate (second core material), Zirconium oxide (radiopacifier), calcium carbonate and calcium oxide (fillers), iron oxide (shade). Liquid consists of calcium chloride (accelerator) and hydro soluble polymer (water reducing agent) [3].

Bio-dentine stimulates dentin regeneration by inducing odontoblast differentiation from pulp progenitor cells, resulting in a hard apical barrier. It forms tag like structures composed of the material itself or calcium or phosphate rich crystalline deposits with dentin. These calcium and silicate rich layers increase in thickness over a period of 30 to 90 days [13]. The ability of calcium silicate to interact with water leads to setting and hardening of the cement [3]. Strength improves over 300 Mpa in over a month due to decrease in porosity with time. Based on a study conducted by Kokate and Pawar, Biodentine exhibited least micro leakage. The push out strength of bio-dentine was better than MTA [13].

Bio-dentine exhibited chemico-mechanical bonding to tooth surface. It has a short setting time (9–12 minutes) which is due to smaller particle size, calcium chloride accelerator and less amount of liquid required for setting [14].

Bio-dentine is packed into the meticulously cleaned and shaped canal incrementally using hand pluggers, finger pluggers, applicator tips, cotton pellets, amalgam carriers etc. Material from canal walls is pushed apically before the material sets, using cotton pellet or suitably sized Gutta-percha point. The canal is then obturated using a suitable technique.

While treating failed cases, disinfection of canal and preventing recurrence of periapical lesion is extremely important. "Lesion sterilization and tissue repair" (LSTR) is based on the concept of thorough disinfection causing suppression of root canal pathogens and allow better healing of periapical tissue. This concept suggests the use of "Triple Antibiotic Paste" containing Ciprofloxacin, Metronidazole and Minocycline (100 micrograms each/ml) as intracanal medicament [12].

In this present case, both calcium hydroxide and Bio-dentine were used as apexification materials. Though we started with calcium hydroxide in both the central incisors (11, 21), at the end of 6 months, favourable results were not obtained in right central incisor (11). Left central incisor (21) was favourable for obturation. Since the patient did not present with any sign of re-infection in the tooth (11), this need not be considered as a case of failure. A fresh dressing with calcium hydroxide over a period of time could have probably resulted in a favourable situation for obturation in 11. But the inability of the patient to report for further multiple visits made us change the treatment plan to a single visit apexification procedure.

Thereby, considering the improved physical, biocompatible and antibacterial properties, Bio-dentine was chosen and single visit apexification procedure was done.

Conclusion

Although the results of such case reports and research works with biodentine are promising, long term follow up and extensive study with the material will warrant the success rate of Biodentine.

References

1. Bhasker SN. Orban's oral histology and embryology, 11th ed. St. Louis: Mosby-Year Book; 1991; p382.
2. American Association of Endodontists: Glossary of endodontic terms.
3. Nayak G, Hasan MF. Biodentine a novel dentinal substitute for single visit apexification. Restor Dent Endod. 2014; 39: 120-125.
4. Bajwa NK, Jingarwar MM, Pathak A. Single Visit Apexification Procedure of a Traumatically Injured Tooth with a Novel Bioinductive Material (Biodentine). Int J Clin Pediatr Dent. 2015; 8: 58-61.
5. Pawar AM, Kokate SR, Pawar MG, Hegde VR. Apexification of non-vital central incisors with open apices using conventional approach of calcium hydroxide dressings and contemporary approach of artificial apical barrier by apical plug of biodentine: Report of two cases. Univ Restor J Dent. 2013; 3: 79-82.
6. Silva L, Nelson-Filho P, Leonardo MR, Rossi MA, Pansani CA. Effect of calcium hydroxide on bacterial endotoxin in vivo. J Endod. 2002; 28: 94-98.
7. Ham KA, Witherspoon DE, Gutmann JL, Ravindranath S, Gait TC, Opperman LA. Preliminary evaluation of BMP-2 expression and histological characteristics during apexification with calcium hydroxide and mineral trioxide aggregate. J Endod. 2005; 31: 275-279.
8. Estrela C, Holland R. Calcium hydroxide: study based on scientific evidences. J Appl Oral Sci. 2003; 11: 269-282.
9. Pawar AM, Pawar SM, Pawar MG, Kokate SR. Retreatment of endodontically failed tooth with wide-open apex using platelet rich fibrin membrane as matrix and an apical plug of Biodentine™. Eur J Gen Dent. 2015; 4: 150-154.

10. Torabinejad M, Watson TF, Pitt Ford TR. Sealing ability of mineral trioxide aggregate when used as a root end filling material. J Endod. 1993; 19: 591-595.
11. Villat C, Grosgogeat B, Seux D, Farge P. Conservative approach of a symptomatic carious immature permanent tooth using tricalcium silicate cement (Biodentine): a case report. Restor Dent Endod. 2013; 38: 258-262.
12. Sinha N, Singh B, Patil S. Cone beam-computed topographic evaluation of a central incisor with an open apex and a failed root canal treatment using one-step apexification with Biodentine™: A case report. J Conserv Dent. 2014; 17: 285-289.
13. Khetarpal A, Chaudhary S, Talwar S, Verma M. Endodontic management of open apex using Biodentine as a novel apical matrix. Indian J Restor Dent. 2014; 25: 513-516.
14. Septodont. Biodentine-Active Biosilicate Technology, scientific file. Saint-Maur-des-Fosses Cedex, France: R&D Department, Septodont. 2010.

Citation: Revathy V, Abharna R, Sathya R, Suganthi, Janak HK. Endodontic Management of Immature Non-vital Permanent Teeth with Two Apexification Materials. Viv J Dent Sci. 2018; 1: 2018090001.