

RETROSPECTIVE ANALYSIS ON BIOCERAMIC MATERIAL USED IN APEXIFICATION

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Abstract;

Background; Apexification is a method to induce calcified barriers in root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp. In the past, techniques for management of the open apex in non-vital teeth were confined to custom firing the filling material, paste fills and apical surgery. The objective of this study was to evaluate the bioceramic material used in apexification.

Aim; To analyze the bioceramic material used in apexification.

Materials and methods; All the cases reported for endodontic treatment between June 2019 and April 2020 were considered in this study. The details of patients who underwent apexification were retrieved from dental information archiving systems, SDC, SIMATS. Bioceramic material used in apexification was analysed, Data recorded in excel and was subjected to statistical analysis.

Results; From the statistical analysis, it can be observed that the most preferred bioceramic material used for apexification is MTA followed by biodentin.

Conclusion; within the limitations of the present study, it can be concluded that the most commonly used bioceramic material is MTA for apexification. The success rate observed in this study should be confirmed through randomised controlled trials with long follow up periods.

Keywords; Apexification, MTA, Biodentin, bioceramic materials, open apex management

INTRODUCTION;

Endodontic treatment of immature teeth with incompletely formed roots can result in complications that necessitate special precaution. It is important to induce the closure of the apical foramen with mineralized tissue and to create an artificial apical barrier to allow for condensation of the root filling material and promote an apical seal.(1) Apexification is a method to induce a calcified barrier in a root with an open apex or apical development of an incomplete root in teeth with necrotic pulp. In the past, techniques for management of the open apex in non-vital teeth were confined to custom fitting the filling material, pastes, and apical

surgery.(2) The use of custom- fitted gutta-percha cones is not advisable as the apical portion of the root is wider than the coronal portion, making proper condensation of the gutta-percha impossible. The sufficient widening of the coronal segment to make its diameter greater than that of the apical portion would significantly weaken and increase the risk of fracture.(3)(4) The disadvantages of surgical intervention are difficulty of obtaining the necessary apical seal in the immature pulpless tooth with its thin, fragile, irregular walls at the root apex. These walls may shatter during the preparation of the condensation of the filling material. The wide foramen results in a large volume of filling material and a compromised seal.(5) Apicoectomy further reduces the root length resulting in a very bad crown root ratio. The limited success enjoyed by these procedures resulted in significant interest in the phenomenon of continued apical development of an apical barrier, first proposed in the 1960s.(6)(6,7)

Mineral trioxide aggregate (MTA) has been considered the material of choice for endodontic therapies because of its high mineralization capacity and relatively few inflammatory reactions in clinical use. ((4)also, the interactions between MTA and human osteoblast-like cells, cementoblasts, PDL fibroblasts, and gingival fibroblasts have demonstrated its capability for regenerative endodontic procedures.(8)(9) Bioceramics composed of dicalcium silicate, tricalcium silicate, calcium phosphate monobasic, amorphous silicon dioxide, and tantalum pentoxide.(10) Due to their ability to penetrate dentinal tubules and to interact with moisture of dentine, an optimum dimensional stability and the least amount of shrinkage can be expected.(11) Compared to white mineral trioxide aggregate (MTA), bioceramics offer the advantage of being aluminium free and contain tantalum pentoxide as an opacifier.(12) Bioceramics can induce differentiation of human PDL fibroblasts and their bioactivity is comparable with that of MTA. They also have an alkaline pH of 12.8, which is responsible for antibacterial activity.(13) Bioceramics have advantages such as biocompatibility, high resistance to wash out,lack of shrinkage and also display good physical properties.(14) The syringe eliminates the need for hand instruments and the need for mixing. The bioceramic particle size is less than 2 μ thus can be delivered by a 0.012 capillary tip which allows premixed material to be placed by syringe. Also, these materials have a compressive strength of 50- 70 MPa.(15) further studies are necessary to evaluate using these materials for the apical barrier. Our team has extensive knowledge and research experience that has translate into high quality publications(16–25), (26–29), (30–34)(35). Therefore, the objective of this study is to analyze the bioceramic material used in apexification.(36)

MATERIALS AND METHODS:

In the current study, a total of 56 patients of different age groups and genders who underwent apexification at saveetha dental college and hospitals were recruited

Inclusion criteria: patients of all age groups and genders with apexification procedure done

Exclusion criteria: patients who hadn't undergone any endodontic surgical procedures.

This is a retrospective study, in which the data of all patients from June 2019 to February 2021 were retrieved from dental information archiving systems, SDC, SIMATS. All the case sheets

were approved and verified by external reviewers. Further cross verification of data was done with photographs to avoid errors. During data collection patients of all age groups and gender who underwent apexification were included and details of patients without apexification treatment were excluded. Data was then imported to SPSS by IBM, in which the frequency of age, gender tooth involved in apexification were assessed. Parametric and non parametric tests were done by running a chi-square test and parameters considered were statistically analysed and interpreted.

RESULTS:

A total of 56 immature permanent teeth were treated in this clinical study. Large number of males patients(74%) underwent apexification than females. The maxillary central incisors were the most commonly involved tooth in our study. Pulp involvement due to trauma was recorded in 75% of the affected incisors while 25% of involvement was due to extensive caries. Graph 1: Bar graph showing percentage of male and female who had undergone apexification. X axis shows gender and Y axis shows percentages. It is evident from the graph that a larger number of male underwent apexification than females. With regard to the percentage of number of apexification done. Male (74%) and female (25%) underwent open apex management. Graph 2: Bar graph showing percentage of materials used for apexification. X axis shows the type of materials and Y axis shows percentage. It is evident from the graph that MTA is most commonly used for apexification than the other materials. Percentage of MTA (78%) used for apexification is higher than the biodentine (16%). Graph 3: Bar graph showing frequency of pre operative radiological findings among the study groups, X axis shows type of material and Y axis shows present or absent. Among both biodentine and MTA groups. Periapical radiolucency was present In both biodentin and MTA. Graph 4: Bar graph showing frequency of postoperative radiological findings among the study group. X axis shows type of materials and Y axis shows reduced or not reduced. Regarding the postoperative finding of both materials after 2 and 3 months of follow you, all teeth show normal laminate dura among both groups, whole reduced radiolucency and obvious healing of bone detected among 68% of the teeth among the MTA group respectively.

DISCUSSION:

The periapical lesion is the most common sequelae of pulp necrosis due to carious lesion or trauma. Many materials have been used for apical closure and periapical repair but the exact mechanism of action is unknown(3). A permanent treatment is to minimize the chances of reinfection which can result in apical periodontitis and inhibit canal closure. The main goal of the current study is to obtain an apical barrier to prevent the passage of toxins and bacteria, because dental caries or injuries may cause microbes to enter the dental pulp.(37) This may cause inflammatory changes in the pulp that are irreversible. Pulp necrosis is the outcome of irreversible pulpitis, which is a diagnosis based on subjective and objective findings indicating that the clinically normal inflamed pulp is incapable of healing.(38) The susceptibility of microbial invasion of dental pulp due to dental caries or traumatic injuries increases after the

emergence of the young permanent tooth in the oral cavity, when the roots are still developing.(39) Bioceramics are biocompatible compounds obtained both in situ and in vivo, by various chemical process. Bioceramics exhibit excellent biocompatibility properties due to their similarity with biological hydroxyapatite. Bioceramics produce during the hydration process, different compounds, e.g. hydroxyapatites with the ability to induce a regenerative response in the human body.

The first choice material to achieve apexification has been used was Calcium Hydroxide, which requires 5-20 months and repeated applications for inducing the formation of a calcific barrier. The long course of treatment includes several obstacles such as the dislodgement of the temporary restoration, increased chances of infection as well as the requisite high level patient compliance. To overcome this, a single visit apexification procedure has been proposed MTA, when used for root-end filling, has a excellent sealing ability while being biocompatible as well as bacteriostatic. It is thus considered a suitable material for a single visit apexification

In the current study, the apexification technique was used because this technique is considered the most (40) reliable for testing new materials, as it allows them to exhibit their primary effect on the tissue. Access cavity prepared to allow debridement of the canal, irrigation of the canal with NAOCL 5% to disinfection and cleaning of the canal.(41) BioDentine was evaluated because it is a new type of bioactive cement with the capacity in formation of new cementum and periodontal ligament, making it biologically acceptable for closing root canals with open apices. However, Lee et al. have recommended the use of BioDentine as well as MTA as root-end filling materials because, in contact with mesenchymal stem cells, they induce osteoblast differentiation. In the present study in regard to the positive response observed in group A, the success rate was approximately (90%). These results were in agreement with other researchers. Pace R, et al.(42) suggest that apical plug with MTA was a successful and effective technique for long-term management of teeth with necrotic pulps with immature root development and periapical lesions. Johannes M, et al.(43) supported the management of open apical foramina with mineral trioxide aggregate apical plugs. The success rate is due to the good sealing ability of MTA, biocompatibility, and dimensional stability.(44) MTA has a pH of 12.5 after setting which is similar to the pH of calcium hydroxide and it has been suggested that this may impart some antimicrobial properties In the present study bioceramic, root canal sealer was used to manage open apex. Bioceramics are highly successful endodontic sealers and have several advantages such as improved biocompatibility, sealing ability, anti-bacterial, ease of application, and an increase in strength of root following obturation.(45) The extreme biocompatibility of bioceramics can also be observed in cases of root repair where there is an absence of inflammation and pain or minimal pain the following overfill during obturation.(46,47) Bioceramics are hydrophilic and can form hydroxyapatite. They lead to the formation of a chemical bond between the filling material and dentin walls. This eliminates the presence of any space between the dentinal walls and sealer which enhances the seal. The bioceramic sealer has a particle size of 2 microns aiding in its delivery by the means of a

capillary tip. Bioceramics have shown radiopacity and flow in accordance with ISO 6876/2001 recommendations

CONCLUSION:

Bioceramic root canal sealer- MTA recorded successful clinical and radiographic outcomes in the apexification of immature permanent teeth.

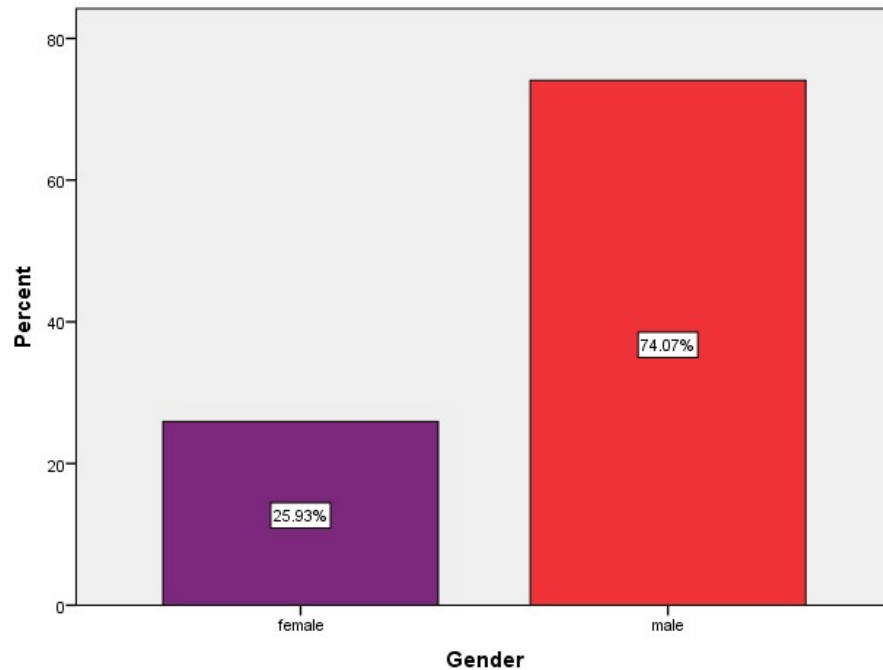
REFERENCE:

- M G, Goldberg M. Apexogenesis & Apexification [Internet]. Journal of Biomedical and Allied Research. 2019. Available from: [http://dx.doi.org/10.37191/mapsci-2582-4937-1\(2\)-010](http://dx.doi.org/10.37191/mapsci-2582-4937-1(2)-010)
- Tasch GE. Histopathological Evaluation of the Effects of Calcium Hydroxide in Inducing Apexification of Nonvital Monkey Teeth: A Thesis Submitted in Partial Fulfillment ... Endodontics. 1971. 220 p.
- Rakhmanova MS, Korolenkova MV. [Comparative analysis of calcium hydroxide apexification and regenerative endodontic procedure for root dentine growth stimulation in immature incisors with pulp necrosis]. Stomatologia . 2020;99(6):55–63.
- Estiyaningsih T, Rulianto M. Apexification of an Immature Permanent Central Incisor with Mineral Trioxide Aggregate [Internet]. Proceedings of the 7th International Meeting and the 4th Joint Scientific Meeting in Dentistry. 2017. Available from: <http://dx.doi.org/10.5220/0007295102120216>
- Onizuka K. A Radiological and Electron Microscopic Study of Apical Hard Tissue after Apexification [Internet]. Vol. 40, The Journal of the Kyushu Dental Society. 1986. p. 165–87. Available from: <http://dx.doi.org/10.2504/kds.40.165>
- Vidal K, Martin G, Lozano O, Salas M, Trigueros J, Aguilar G. Apical Closure in Apexification: A Review and Case Report of Apexification Treatment of an Immature Permanent Tooth with Biodentine [Internet]. Vol. 42, Journal of Endodontics. 2016. p. 730–4. Available from: <http://dx.doi.org/10.1016/j.joen.2016.02.007>
- Rokaya ME, Hafiz EA. Evaluation of one-visit apexification with MTA apical plug versus traditional Calcium hydroxide apexification with the help of Platelet Rich Fibrin apical matrix [Internet]. Vol. 65, Egyptian Dental Journal. 2019. p. 681–90. Available from: <http://dx.doi.org/10.21608/edj.2019.72829>
- Maru V, Dixit U, Patil RSB, Parekh R. Cytotoxicity and Bioactivity of Mineral Trioxide Aggregate and Bioactive Endodontic Type Cements: A Systematic Review. Int J Clin Pediatr Dent. 2021 Jan;14(1):30–9.
- Xu D, Mutoh N, Ohshima H, Tani-Ishii N. The effect of mineral trioxide aggregate on dental pulp healing in the infected pulp by direct pulp capping. Dent Mater J [Internet]. 2021 Jul 27; Available from: <http://dx.doi.org/10.4012/dmj.2020-393>
- Cordell S, Kratunova E, Marion I, Alranyes S, Alapati SB. A Randomized Controlled Trial Comparing the Success of Mineral Trioxide Aggregate and Ferric Sulfate as Pulpotomy Medicaments for Primary Molars. J Dent Child . 2021 May 15;88(2):120–8.

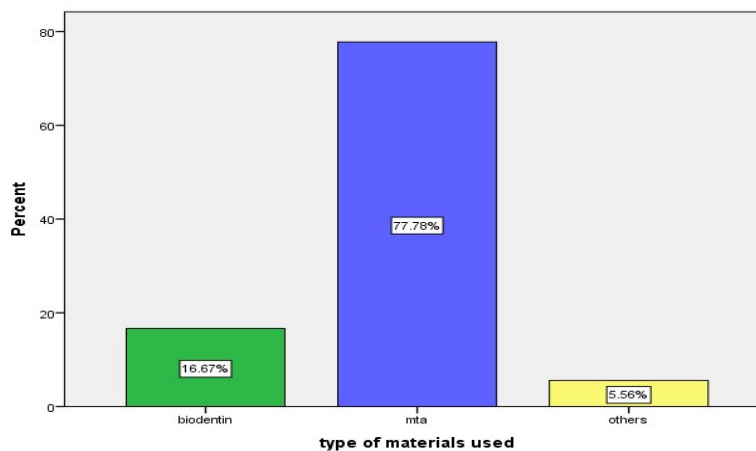
- Kaul R, Choudhary A, Kour S, Singh A, Kumari N, Manish K. Comparison between Mineral Trioxide Aggregate Mixed with Water and Water-based Gel Regarding Shear Bond Strength with Resin-modified Glass Ionomer Cement and Composite. *J Contemp Dent Pract.* 2021 Apr 1;22(4):353–6.
- Tucker RL, Ha WN. A Systematic Review Comparing Mineral Trioxide Aggregate to Other Commercially Available Direct Pulp Capping Agents in Dogs. *J Vet Dent.* 2021 Mar;38(1):34–45.
- Tek GB, Keskin G. Use of Mineral Trioxide Aggregate with or without a Collagen Sponge as an Apical Plug in Teeth with Immature Apices. *J Clin Pediatr Dent.* 2021 Jul 1;45(3):165–70.
- Tanomaru-Filho M, Guerreiro-Tanomaru JM. Properties of Hydrated Mineral Trioxide Aggregate [Internet]. *Mineral Trioxide Aggregate in Dentistry.* 2014. p. 37–59. Available from: http://dx.doi.org/10.1007/978-3-642-55157-4_3
- Tay FR. Bioactivity of Mineral Trioxide Aggregate and Mechanism of Action [Internet]. *Mineral Trioxide Aggregate in Dentistry.* 2014. p. 61–85. Available from: http://dx.doi.org/10.1007/978-3-642-55157-4_4
- Muthukrishnan L. Imminent antimicrobial bioink deploying cellulose, alginate, EPS and synthetic polymers for 3D bioprinting of tissue constructs. *Carbohydr Polym.* 2021 May 15;260:117774.
- PradeepKumar AR, Shemesh H, Nivedhitha MS, Hashir MMJ, Arockiam S, Uma Maheswari TN, et al. Diagnosis of Vertical Root Fractures by Cone-beam Computed Tomography in Root-filled Teeth with Confirmation by Direct Visualization: A Systematic Review and Meta-Analysis. *J Endod.* 2021 Aug;47(8):1198–214.
- Chakraborty T, Jamal RF, Battineni G, Teja KV, Marto CM, Spagnuolo G. A Review of Prolonged Post-COVID-19 Symptoms and Their Implications on Dental Management. *Int J Environ Res Public Health* [Internet]. 2021 May 12;18(10). Available from: <http://dx.doi.org/10.3390/ijerph18105131>
- Muthukrishnan L. Nanotechnology for cleaner leather production: a review. *Environ Chem Lett.* 2021 Jun 1;19(3):2527–49.
- Teja KV, Ramesh S. Is a filled lateral canal - A sign of superiority? *J Dent Sci.* 2020 Dec;15(4):562–3.
- Narendran K, Jayalakshmi, Ms N, Sarvanan A, Ganesan S A, Sukumar E. Synthesis, characterization, free radical scavenging and cytotoxic activities of phenylvilangin, a substituted dimer of embelin. *ijps* [Internet]. 2020;82(5). Available from: <https://www.ijpsonline.com/articles/synthesis-characterization-free-radical-scavenging-and-cytotoxic-activities-of-phenylvilangin-a-substituted-dimer-of-embelin-4041.html>
- Reddy P, Krithikadatta J, Srinivasan V, Raghu S, Velumurugan N. Dental Caries Profile and Associated Risk Factors Among Adolescent School Children in an Urban South-Indian City. *Oral Health Prev Dent.* 2020 Apr 1;18(1):379–86.
- Sawant K, Pawar AM, Banga KS, Machado R, Karobari MI, Marya A, et al. Dentinal Microcracks after Root Canal Instrumentation Using Instruments Manufactured with

- Different NiTi Alloys and the SAF System: A Systematic Review. *NATO Adv Sci Inst Ser E Appl Sci.* 2021 May 28;11(11):4984.
- Bhavikatti SK, Karobari MI, Zainuddin SLA, Marya A, Nadaf SJ, Sawant VJ, et al. Investigating the Antioxidant and Cytocompatibility of *Mimusops elengi* Linn Extract over Human Gingival Fibroblast Cells. *Int J Environ Res Public Health* [Internet]. 2021 Jul 4;18(13). Available from: <http://dx.doi.org/10.3390/ijerph18137162>
 - Karobari MI, Basheer SN, Sayed FR, Shaikh S, Agwan MAS, Marya A, et al. An In Vitro Stereomicroscopic Evaluation of Bioactivity between Neo MTA Plus, Pro Root MTA, BIODENTINE & Glass Ionomer Cement Using Dye Penetration Method. *Materials* [Internet]. 2021 Jun 8;14(12). Available from: <http://dx.doi.org/10.3390/ma14123159>
 - Rohit Singh T, Ezhilarasan D. Ethanolic Extract of *Lagerstroemia Speciosa* (L.) Pers., Induces Apoptosis and Cell Cycle Arrest in HepG2 Cells. *Nutr Cancer.* 2020;72(1):146–56.
 - Ezhilarasan D. MicroRNA interplay between hepatic stellate cell quiescence and activation. *Eur J Pharmacol.* 2020 Oct 15;885:173507.
 - Romera A, Peredpaya S, Shparyk Y, Bondarenko I, Mendonça Bariani G, Abdalla KC, et al. Bevacizumab biosimilar BEVZ92 versus reference bevacizumab in combination with FOLFOX or FOLFIRI as first-line treatment for metastatic colorectal cancer: a multicentre, open-label, randomised controlled trial. *Lancet Gastroenterol Hepatol.* 2018 Dec;3(12):845–55.
 - Raj R K, D E, S R. β -Sitosterol-assisted silver nanoparticles activates Nrf2 and triggers mitochondrial apoptosis via oxidative stress in human hepatocellular cancer cell line. *J Biomed Mater Res A.* 2020 Sep;108(9):1899–908.
 - Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. *J Periodontol.* 2019 Dec;90(12):1441–8.
 - Priyadharsini JV, Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen *A. baumannii* and related species [Internet]. Vol. 94, *Archives of Oral Biology.* 2018. p. 93–8. Available from: <http://dx.doi.org/10.1016/j.archoralbio.2018.07.001>
 - Uma Maheswari TN, Nivedhitha MS, Ramani P. Expression profile of salivary micro RNA-21 and 31 in oral potentially malignant disorders. *Braz Oral Res.* 2020 Feb 10;34:e002.
 - Gudipani RK, Alam MK, Patil SR, Karobari MI. Measurement of the Maximum Occlusal Bite Force and its Relation to the Caries Spectrum of First Permanent Molars in Early Permanent Dentition. *J Clin Pediatr Dent.* 2020 Dec 1;44(6):423–8.
 - Chaturvedula BB, Muthukrishnan A, Bhuvaraghan A, Sandler J, Thiruvenkatachari B. *Dens invaginatus*: a review and orthodontic implications. *Br Dent J.* 2021 Mar;230(6):345–50.
 - Kanniah P, Radhamani J, Chelliah P, Muthusamy N, Joshua Jebasingh Sathiy Balasingh E, Reeta Thangapandi J, et al. Green synthesis of multifaceted silver nanoparticles using the flower extract of *Aerva lanata* and evaluation of its biological and environmental applications. *ChemistrySelect.* 2020 Feb 21;5(7):2322–31.

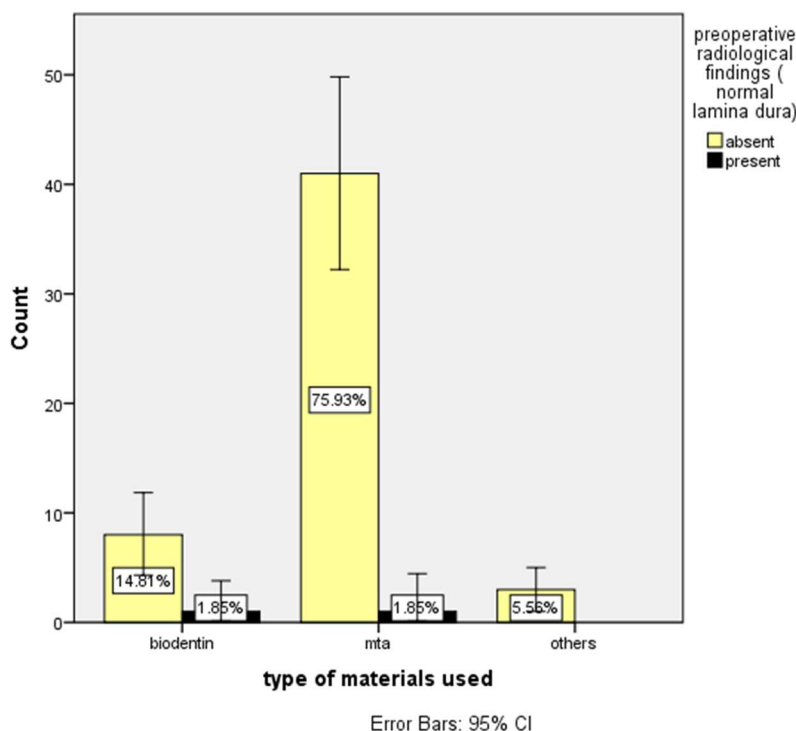
- Saghiri MA, Asgar K, Lotfi M, Garcia-Godoy F. Nanomodification of mineral trioxide aggregate for enhanced physiochemical properties [Internet]. Vol. 45, International Endodontic Journal. 2012. p. 979–88. Available from: <http://dx.doi.org/10.1111/j.1365-2591.2012.02056.x>
- Antony DP, Thomas T, Nivedhitha MS. Two-dimensional Periapical, Panoramic Radiography Versus Three-dimensional Cone-beam Computed Tomography in the Detection of Periapical Lesion After Endodontic Treatment: A Systematic Review [Internet]. Cureus. 2020. Available from: <http://dx.doi.org/10.7759/cureus.7736>
- Tariq A. The Management of a Persistent Periapical Lesion in Endodontically Treated Teeth: About Two Case Reports [Internet]. Vol. 4, Open Access Journal of Dental Sciences. 2019. Available from: <http://dx.doi.org/10.23880/oajds-16000213>
- Barnett F, Schwartzben LJ, Tronstad L. Extensive periapical lesion with inconsistent radiographic findings [Internet]. Vol. 10, Journal of Endodontics. 1984. p. 26–7. Available from: [http://dx.doi.org/10.1016/s0099-2399\(84\)80249-6](http://dx.doi.org/10.1016/s0099-2399(84)80249-6)
- Mohorn HW. Generalized Edema and the Odontic Periapical Lesion: A Dissertation [sic] Submitted in Partial Fulfillment ... Endodontics .. 1968. 130 p.
- Abidin T. EFFECT OF OCCLUSAL TRAUMA ON HEALING OF PERIAPICAL LESION (CASE REPORT) [Internet]. Vol. 13, Journal of Dentistry Indonesia. 2008. Available from: <http://dx.doi.org/10.14693/jdi.v13i2.324>
- Pace R, Giuliani V, Di Nasso L, Pagavino G, Franceschi F, Lorenzo F. Regenerative Endodontic Therapy using a New Antibacterial Root Canal Cleanser in necrotic immature permanent teeth: Report of two cases treated in a single appointment. Clin Case Rep. 2021 Apr;9(4):1870–5.
- Saatchi M. Healing of large periapical lesion: A non-surgical endodontic treatment approach [Internet]. Vol. 33, Australian Endodontic Journal. 2007. p. 136–40. Available from: <http://dx.doi.org/10.1111/j.1747-4477.2007.00061.x>
- Camilleri J. Mineral Trioxide Aggregate in Dentistry: From Preparation to Application. Springer; 2014. 206 p.
- Kumar R. Mineral Trioxide Aggregate - a Review. LAP Lambert Academic Publishing; 2012. 72 p.
- Mahmoud O, University of Newcastle upon Tyne. Institute of Health and Society. Mineral Trioxide Aggregate (MTA) in Dentistry: Its Characteristics and Consequences of Serum Contamination. 2009. 408 p.
- Jaiswal MM, Kumari N, Singh S. Mineral Trioxide Aggregate in Dentistry. Walnut Publication; 2020.



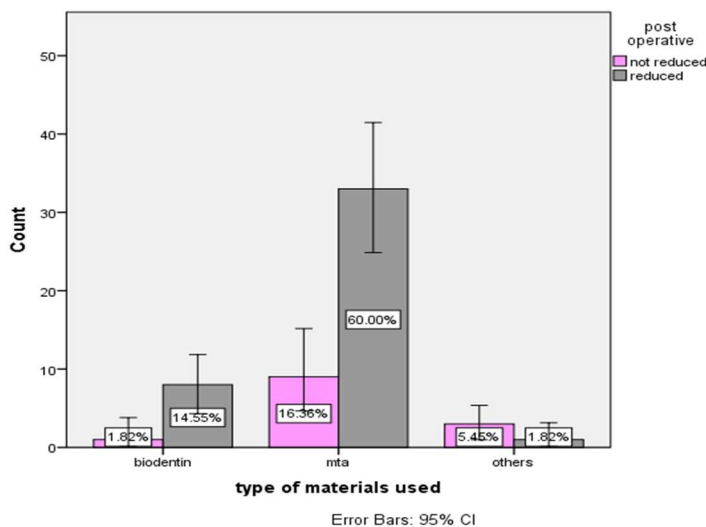
Graph 1: Bar graph showing percentage of male and female who had undergone apexification. X axis shows gender and Y axis shows percentages. Purple colour represents the female and red colour represents the male. It is evident from the graph that a larger number of male underwent apexification than females. With regard to the percentage of number of apexification done. Male (74%) and female (25%) underwent open apex management.



Graph 2: Bar graph showing percentage of materials used for apexification. X axis shows the type of materials and Y axis shows percentage. Green colour represents the biocentine, blue colour represents the MTA and yellow colour represents the other materials. It is evident from the graph that MTA is most commonly used for apexification than the other materials. Percentage of MTA (77%) used for apexification is higher than the biocentine (16%)



Graph 3: Bar graph showing frequency of pre operative radiological findings among the study groups, X axis shows type of material and Y axis shows present or absent. Among both biodentine and MTA groups. Periapical radiolucency was present in both biodentine and MTA. (Chi-square, $p > 0.05$ - not significant)



Graph 4: Bar graph showing frequency of postoperative radiological findings among the study group. X axis shows type of materials and Y axis shows reduced or not reduced. Pink colour represents reduced radiolucency and grey colour represents not reduced radiolucency. Regarding the postoperative finding of both materials after 2 and 3 months of follow up, all teeth show normal laminate dura among both groups, whole reduced radiolucency and obvious healing of bone detected among 68% of the teeth among the MTA group respectively. (Chi-square, $p > 0.05$ - not significant)