

*Type of manuscript: Retrospective study*

# **Analysis of Pulp Capping Procedures Done in Permanent Molars in A University Setting - A Retrospective Study**

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## **Abstract**

Direct and indirect pulp capping are the treatment choices to maintain integrity and health of dental pulp. Direct pulp capping is used when pulp is visibly exposed due to caries, trauma or iatrogenic causes. Indirect pulp capping generally performed on teeth with deep cavity preparations with or without caries remaining. Many authors have reported regarding pulp capping materials. The aim of this retrospective study was to analyse the practice of pulp capping procedure based on age, gender, tooth number and pulp capping materials. Data regarding pulp capping procedures that were recorded between June 2019 to March 2020 were retrieved from the patients management software of Saveetha Dental College, Chennai. Data that was retrieved then evaluated by 2 viewers. Cases with incomplete documentation or double entries were excluded from this study. Data from the Excel sheet was imported to SPSS for statistical analysis. Chi-square test was done to assess the association between age, gender, tooth types, type of pulp capping and pulp capping material. This study showed a statistically significant difference between age and tooth number; tooth number and pulp capping materials (  $p < 0.05$ ). It was seen that lower molars underwent significantly more pulp capping procedure in the age group of 18-30 years. In lower molars, calcium hydroxide was the widely used pulp capping material.

**Keywords:** *Pulp capping; retrospective; vital pulp; permanent molars*

## **Introduction**

The primary objective for pulp treatment is to preserve integrity and health of dental pulp. Even though a tooth can survive without a vital pulp, it is important to maintain vitality of the pulp. Therefore the objective of direct and indirect pulp capping is to treat reversible pulp injuries <sup>1</sup>. Soon after the eruption, permanent first molars may show extensive caries or are associated with hypoplasia <sup>2</sup>. If it is not treated properly eventually it

will lead to the infections of the pulp and surrounding periapical tissues <sup>3</sup>. For clinicians, one of the most challenging clinical scenarios is the management of pulpally involved immature permanent molars. Root canal treatment would stop opposition of dentin along the canal walls and pulp chamber leaving the tooth with thin dental walls and make it prone for fracture almost in all teeth <sup>4</sup>.

Indirect pulp capping treatment is preferred for teeth with deep carious lesions approximating the pulp but without signs or symptoms of pulp degeneration. The deepest layer of remaining carious dentin will be covered with a biocompatible material to avoid pulp exposure and additional trauma to the tooth. The most commonly used pulp capping materials are calcium hydroxide, zinc oxide eugenol paste (ZnO) and glass ionomer cements. The rationale for indirect pulp capping is that few viable bacteria will remain in deeper dentine layers and will be inactivated once the cavity

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has been sealed properly. The main objective for this procedure is to preserve pulp vitality, by arresting the carious process, promoting dentin sclerosis, stimulating formation of tertiary dentin and remineralize carious dentin. Few studies stated that dentin bonding agents can be used in indirect pulp capping<sup>5</sup>. It was seen that materials such as zinc phosphate cement, amalgam, zinc oxide eugenol cements, polycarbonate cements, glass ionomer cements, resin adhesives and cryanolates does not give predictable success for the procedures. Use of calcium hydroxide was superior but unpredictable<sup>6</sup>.

More recently, better results for pulp capping procedures was achieved by using materials like mineral trioxide aggregate (MTA) and it was statistically significant when compared with formocresol. Removal of the microorganisms from the root canal system is necessary for the successful outcome of any root canal treatment<sup>7</sup>. The activation of irrigants using Endo activator can reduce postoperative effectiveness rather than using endo needles<sup>8</sup>. Remaining dentin thickness is an important parameter for the success rate of root canal treatment<sup>9</sup>. Irrigants play an important role in debridement and disinfection of the root canal space<sup>10</sup>. Dental avulsion can be considered as one of the most severe types of traumatic tooth injuries<sup>11</sup>. Dental traumatic can also lead to pulp canal obliteration<sup>12</sup>. The various reasons for dental trauma are falls, traffic accidents, fights and sports injuries<sup>13</sup>. Dental erosion can be referred to as loss of tooth structure due to chemical processes and not due to bacteria<sup>14</sup>. Dental caries are easily detectable and reversible at an early stage<sup>15</sup>. Non-carious loss of tooth structure in the cervical region is a very common clinical condition in elder patients<sup>16</sup>. A veneer can be referred to as a thin sheet of material which is placed in the front surface of the tooth for aesthetic purposes<sup>17</sup>. Chlorhexidine is an antibacterial used as an antiseptic<sup>18</sup>. Matrix metalloproteinases (MMPs) act as an important role in the efficient tissue turnover and remodeling<sup>19</sup>. Effective root canal disinfection can be achieved by using sodium hypochlorite<sup>20</sup>. Diagnostic aids play a crucial role for a successful treatment plan<sup>21</sup>. The aim of this study was to analyse the practice of pulp capping based on age, gender, tooth number and pulp capping materials.

## Materials and Methods

A university set up was selected for this study which provided easy accessibility for data and provided a population of similar ethnicity for this study. There were two reviewers for analysis of data for this study. The variables that were considered were tooth type, type of pulp capping, pulp capping materials used, age and gender of patients that underwent pulp capping. We reviewed patient records and analysed the data of 86000 between June 2019 to March 2020. The data with complete case history and documentations were included in this study. Incomplete cases or double entries cases were excluded from this study. Final sample size for statistical analysis was 183 patients. Data was then tabulated in Microsoft Excel Sheet and then transferred to SPSS software system. After entering data in SPSS software, variables were verified and association (Chi-square test) was evaluated between age and tooth number; age and types of pulp capping; tooth number and types of pulp capping; tooth number and pulp capping materials.

## Results and Discussion

In the study, we have observed that there was a statistically significant difference between age and tooth number; tooth number and pulp capping materials with p value ( $p < 0.05$ ) (Table 1 & 6). Pulp capping procedures were most predominantly done in patients aged 18 to 30 years old. It was significant in lower molars than upper molars [Bar chart 1]. Patients aged 18 to 30 years old mostly underwent pulp capping compared to the population aged more than 50 years. Based on the association of age with type of pulp capping, it was seen that the population age of 18 to 30 years was the commonest age group that underwent indirect pulp capping followed by population aged 31-40 years, population aged 41-50 years and population aged 50 years and above [Bar chart 2].

Based on the distribution of gender against tooth number, it was observed that male and female populations mostly undergo pulp capping procedures mostly in mandibular molars than in maxillary molars [Bar chart 3]. In the current study, it was observed that in both genders, indirect pulp capping was done more compared to direct pulp capping but was not statistically significant ( $p > 0.05$ ) [Bar chart 4].

Based on the distribution of tooth number against types of pulp capping, it was revealed that indirect pulp capping was done more frequently in both upper and lower molars compared to the direct pulp capping but without statistical significance. [Bar chart 5]. Considering the choice of pulp capping material, it was observed that calcium hydroxide was used with a statistically significant difference compared to MTA in both upper and lower molars [Bar chart 6]. Overall, calcium hydroxide was the most predominant pulp capping material for both direct and indirect pulp capping. [Bar chart 7].

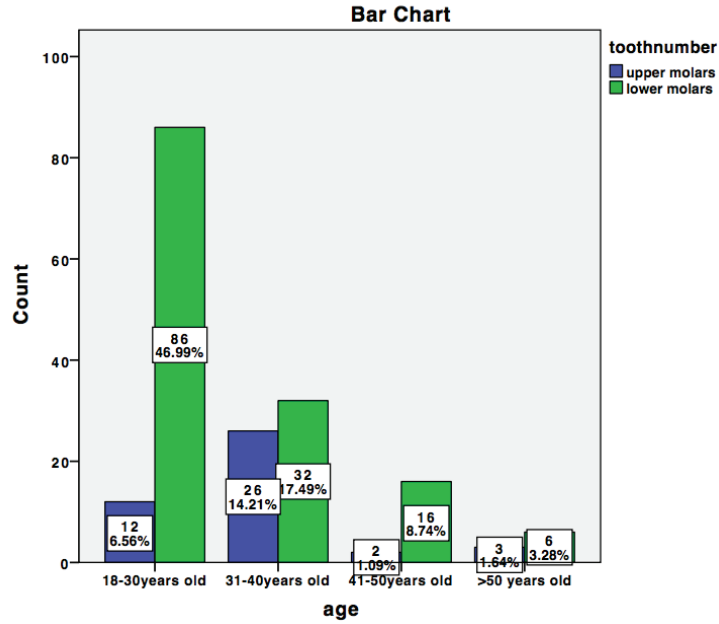
The current study analysed a total of 429 case history for pulp capping procedures and it was found that a total of 183 cases had undergone pulp capping procedures in molars in which 128 of them were male and 55 were female. Pulp capping was done mostly in patients aged 18 to 30 years old with patients over 50 years who minimally undergo pulp capping procedures. Studies have shown that in older patients, the typically more fibrous dental pulp has a reduced ability to overcome insult<sup>22</sup>. Pulp capping in molars with deep cavities were highly prevalent in mandibular jaw compared to maxillary jaw. This finding is similar to study from Luen et al<sup>23</sup> who evaluated ten-year incidence of dental caries in adult and elderly Chinese patients and observed mandibular molars were apparently most susceptible to caries. In addition, Manji and Fejer Skov<sup>24</sup> stated that lower molars were the most severely affected in the entire dentition.

In the present study, calcium hydroxide was highly preferred for pulp capping material either in

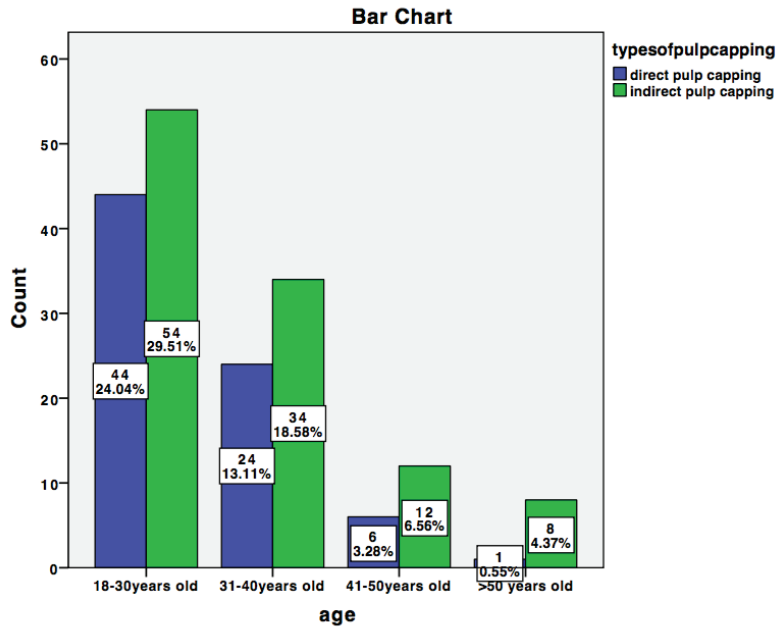
maxillary or mandibular teeth compared to MTA and Ca(OH)<sub>2</sub>+RMGIC. This can be explained by study from Baume et al<sup>6</sup> in which even though MTA is viable and perhaps better option than Ca(OH)<sub>2</sub> and Ca(OH)<sub>2</sub>+RMGIC for pulp capping procedures, traditional powder or liquid formulations of MTA have significant drawbacks such as not user friendly, require very precise mixing, can lead to tooth discolouration, manipulation and placement can be challenging. Furthermore, traditional MTA formulations need long setting time, usually two to four hours, with one study that simulated intraoral condition finding that the MTA formulation tested (Pro root MTA) was still not set even after six hours<sup>25</sup>.

It was observed that male population highly undergone pulp capping procedures compared to females. It also meant that the prevalence of dental caries in male much higher than females. This is in contrast with study from John et al<sup>26</sup> which explained that female populations usually had a higher prevalence for dental caries than male. Higher caries prevalence among females were often explained by factors such as earlier eruption of teeth among girls, therefore longer exposure of girls teeth to cariogenic and environment, easier access to food supplies by women and frequent snacking and pregnancy.

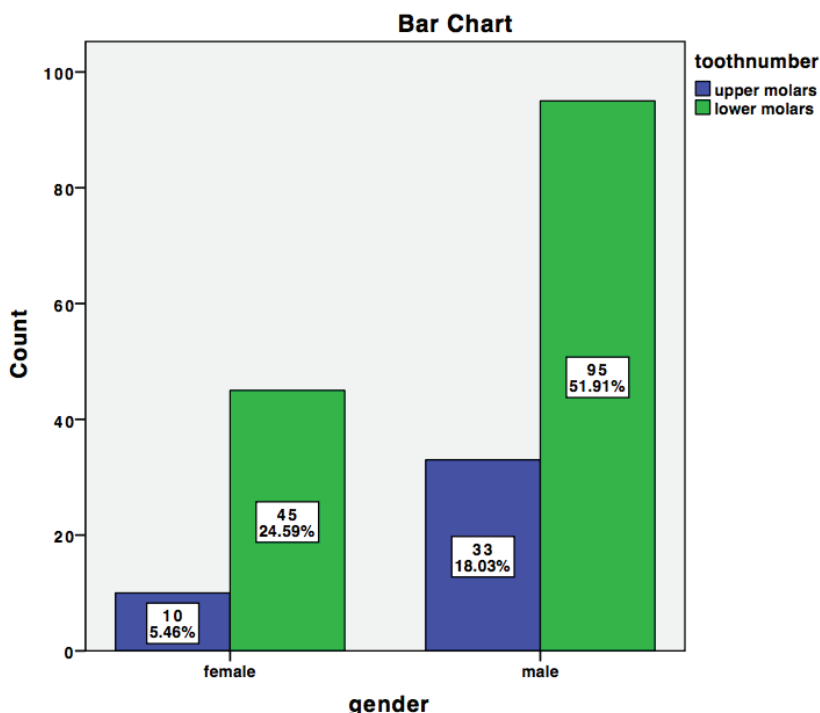
The limitations of this study is that the sample size is small and the retrospective design. Therefore, it does not provide results for the entire population. Further studies to be performed with large sample size. Prospective study designs with longer follow up to be done to evaluate the clinical performance of calcium hydroxide and MTA as pulp capping materials



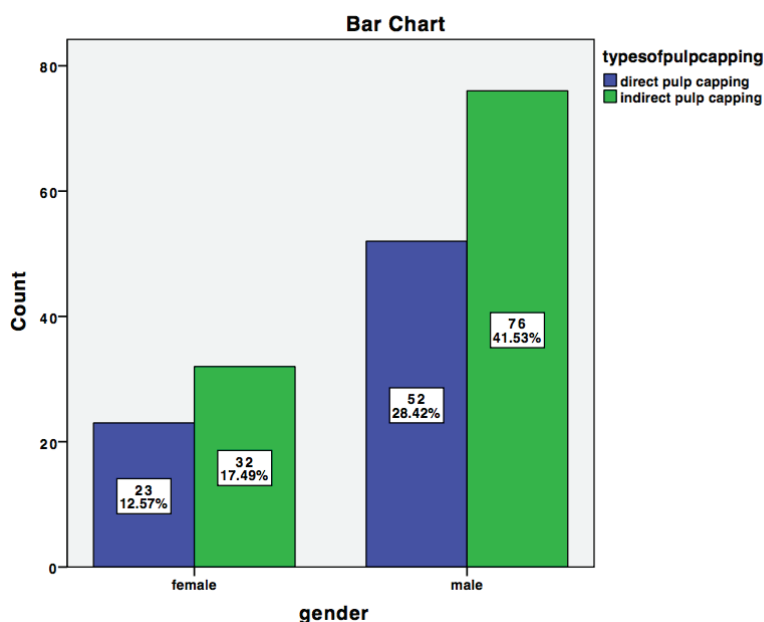
**Bar chart 1:** represents association between age and tooth number where blue colour denotes upper molars and green denotes lower molars. X axis represents the age and Y axis represents the number of pulp capping procedures. Chi square test was done and the association was found to be statistically significant. P value was 0.000 (<0.05). Pulp capping was done highest in lower molars (77%) in all age groups.



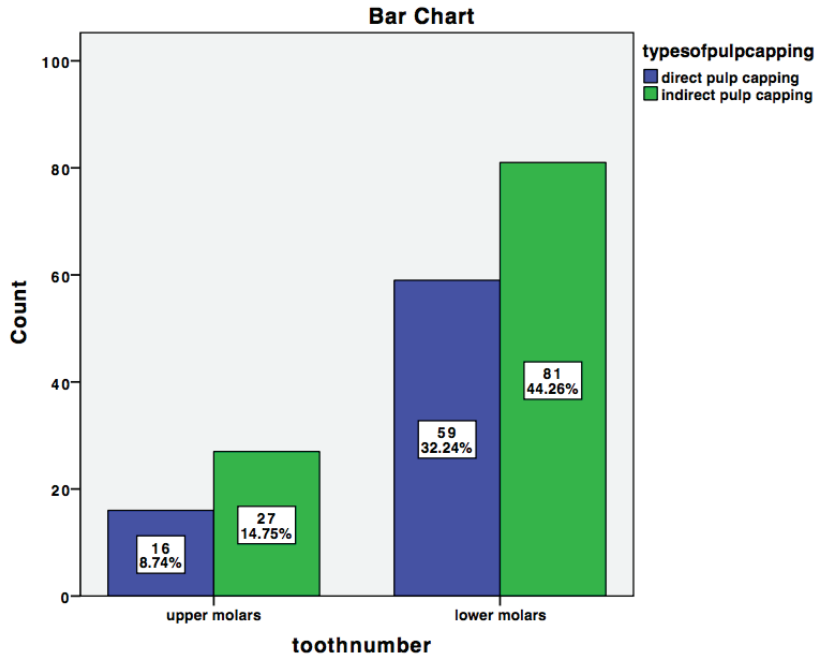
**Bar chart 2:** Bar graph representing association between age and types of pulp capping where blue colour denotes direct pulp capping and green colour denotes indirect pulp capping. X axis represents the age of the population and Y axis represents the number of pulp capping procedures. Chi square test was done and the association was found to be statistically not significant. P value was 0.223 (>0.05). However, indirect pulp capping was more commonly done in all age groups.



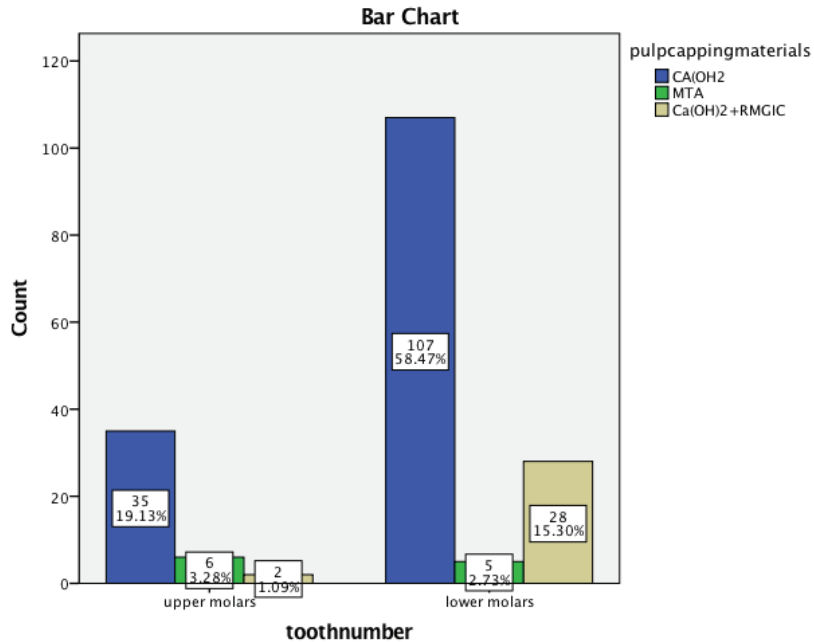
**Bar chart 3:** Bar graph representing association between gender and tooth number where blue colour denotes upper molars and green colour denotes lower molars. X axis represents gender of the population and Y axis represents the number of pulp capping procedures. Chi square test was done and the association was found to be statistically not significant. P value was 0.266 (>0.05). However, pulp capping procedure was done more in lower molars in both the gender



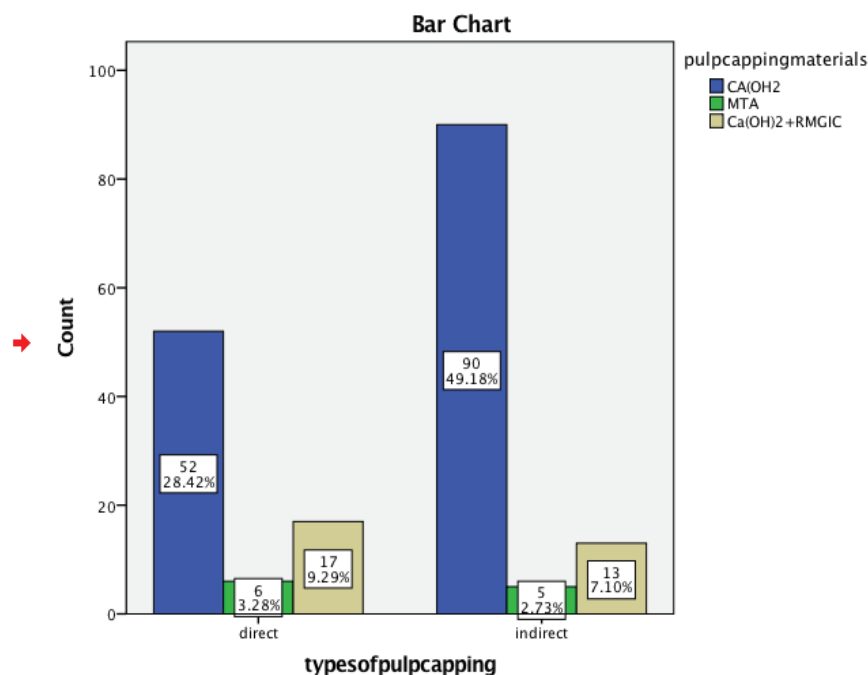
**Bar chart 4:** Bar graph representing association between gender and types of pulp capping where blue colour denotes direct pulp capping and green denotes indirect pulp capping. X axis represents gender of the population and Y axis represents the number of pulp capping procedures. Chi square test was done and the association was found to be statistically not significant. P value was 0.880 (>0.05). However, indirect pulp capping procedure was more commonly followed in both the gender



Bar chart 5: Bar graph representing association between tooth number and types of pulp capping where blue colour denotes direct pulp capping and green colour denotes indirect pulp capping. X axis represents tooth number and Y axis represents the number of pulp capping procedures. Chi square test was done and the association was found to be statistically not significant. P value was 0.5650 (>0.05). However, indirect pulp capping procedure was followed more than direct pulp capping in both upper and lower molars.



Bar chart 6: Bar graph representing association between tooth number and types of pulp capping materials where blue colour denotes Ca(OH)<sub>2</sub>, green denotes MTA and brown colour denotes Ca(OH)<sub>2</sub>+RMGIC. X axis represents tooth number and Y axis represents number of pulp capping procedures. Chi square test was done and the association was found to be statistically significant. P value was 0.05 (=0.05). Ca(OH)<sub>2</sub> was the most commonly used pulp capping agent (78%) in both upper and lower molars.



Bar chart 7: representing association between types of pulp capping and pulp capping materials where blue colour represents Ca(OH)<sub>2</sub>, green denotes MTA and brown colour denotes Ca(OH)<sub>2</sub>+RMGIC. X axis represents types of pulp capping and Y axis represents number of pulp capping procedures. Chi square test was done and the association was found statistically not significant. P value was 0.082 (>0.05). However Ca(OH)<sub>2</sub> was the most common pulp capping material used.

### Conclusion

Within the limitations of the study, it can be concluded that lower molars underwent significantly more pulp capping procedure in the age group of 18-30 years. In lower molars, calcium hydroxide was the widely used pulp capping material.

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**Conflict of Interest :** Nil

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**Ethical Clearance:** It is taken from “Saveetha Institute Human Ethical Committee” (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320

### References

1. Tziafas D, Smith AJ, Lesot H. Designing new treatment strategies in vital pulp therapy. J Dent. 2000 Feb;28(2):77–92.
2. Carrotte P. Endodontic treatment for children. Br Dent J. 2005 Jan 8;198(1):9–15.
3. Martin FE. Carious pulpitis: microbiological and histopathological considerations. Aust Endod J. 2003 Dec;29(3):134–7.
4. Chen J-W, Jorden M. Materials for primary tooth pulp treatment: the present and the future Vol. 23, Endodontic Topics. 2010. p. 41–9.
5. Kashiwada T, Takagi M. New restoration and direct pulp capping systems using adhesive composite resin. Bull Tokyo Med Dent Univ. 1991 Dec;38(4):45–52.
6. Baume LJ, Holz J. Long term clinical assessment of direct pulp capping. Int Dent J. 1981 Dec;31(4):251–60.
7. Manohar M, Sharma S. A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general

- dental practitioners and non endodontic specialists . Vol. 29, Indian Journal of Dental Research. 2018. p. 716.
8. Ramamoorthi S, Nivedhitha MS, Divyanand MJ. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial [Internet]. Vol. 41, Australian Endodontic Journal. 2015. p. 78–87.
  9. Ramanathan S, Solete P. Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study. J Contemp Dent Pract. 2015 Nov 1;16(11):869–72.
  10. Siddique R, Sureshbabu NM, Somasundaram J, Jacob B, Selvam D. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. J Conserv Dent. 2019 Jan;22(1):40–7.
  11. R R, Raja Keerthi R, Ms N. Natural Product as the Storage medium for an avulsed tooth – A Systematic Review [Internet]. Vol. 22, Cumhuriyet Dental Journal. 2019. p. 249–56.
  12. Kumar D, Delphine Priscilla Antony S. Calcified Canal and Negotiation-A Review [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3727.
  13. Jose J, P. A, Subbaiyan H. Different Treatment Modalities followed by Dental Practitioners for Ellis Class 2 Fracture – A Questionnaire-based Survey . Vol. 14, The Open Dentistry Journal. 2020. p. 59–65.
  14. Nasim I, Nandakumar M. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis . Vol. 21, Journal of Conservative Dentistry. 2018. p. 516.
  15. Rajendran R, Kunju Sankaran RN, Sandhya R, Anilkumar A, Santhosh R, Patil SR. Comparative Evaluation of Remineralizing Potential of a Paste Containing Bioactive Glass and a Topical Cream Containing Casein Phosphopeptide-Amorphous Calcium Phosphate: An in Vitro Study. Vol. 19, Pesquisa Brasileira em Odontopediatria e Clínica Integrada. 2019. p. 1–10.
  16. Nasim I, Hussainy S, Thomas T, Ranjan M. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up . Vol. 21, Journal of Conservative Dentistry. 2018. p. 510.
  17. Ravinthar K, Jayalakshmi. Recent Advancements in Laminates and Veneers in Dentistry . Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 785.
  18. Noor SSSE, S Syed Shihaab, Pradeep. Chlorhexidine: Its properties and effects . Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1755.
  19. Teja KV, Ramesh S, Priya V. Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study. J Conserv Dent. 2018 Nov;21(6):592–6.
  20. Teja KV, Ramesh S. Shape optimal and clean more. Saudi Endodontic Journal. 2019 Sep 1;9(3):235.
  21. Janani K, Palanivelu A, Sandhya R. Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study. Brazilian Dental Science. 2020;23(1):8.
  22. Fong CD, Davis MJ. Partial pulpotomy for immature permanent teeth, its present and future. Pediatr Dent. 2002 Jan;24(1):29–32.
  23. Luan W, Baelum V, Fejerskov O, Chen X. Ten-year incidence of dental caries in adult and elderly Chinese. Caries Res. 2000 May;34(3):205–13.
  24. Manji F, Fejerskov O, Baelum V. Pattern of Dental Caries in an Adult Rural Population . Vol. 23, Caries Research. 1989. p. 55–62.
  25. Charland T, Hartwell GR, Hirschberg C, Patel R. An evaluation of setting time of mineral trioxide aggregate and EndoSequence root repair material in the presence of human blood and minimal essential media. J Endod. 2013 Aug;39(8):1071–2.
  26. Dental Caries: Diagnosis, Prevention and Management. BoD – Books on Demand; 2018. 176 p.