

Association between Type Of Pulp Capping and Materials used in University Hospital

Research Article

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Abstract

Aim: To assess the association between the Type of Pulp Capping & Materials used in Chennai.

Materials and Methodology: A retrospective cross sectional study was conducted using the patient record from the Department of Conservative & Endodontic Dentistry, from June 2019 to march 2020. The data of patients who underwent Direct or Indirect Pulp Capping was collected and tabulated. The statistical analysis between type of pulp capping and materials used was carried out in SPSS software. Chi square test was done to compare the parameters.

Results: Majority of patients were seen in the age group 20-30yrs (28.6%) followed by 1-10 yrs (24.1%). Most of the patients who underwent pulp capping were Males (59.9%), followed by the female patients (40.1%). There was an increase in the patients who underwent direct pulp capping when compared to indirect pulp capping (69.2%). The most common material used for pulp capping was calcium hydroxide (82.2%). Chi-square test showed the value P=0.424 which was statistically not significant. (p>0.05).

Conclusion: Within the limitations of the current study, there was no significant association between type of pulp capping and materials used in Chennai. Furthermore research is needed to create awareness about various pulp capping materials in different populations.

Keywords: Calcium Hydroxide; Pulp Capping; MTA.

Introduction

During the last 200 years there have been many changes in the rationale governing the treatment of exposed dental pulps, as it was long ago observed that an exposed pulp healed with great difficulty [1, 2]. Throughout the life of a tooth vital-pulp tissue contributes to the production of secondary dentin, peritubular dentin (sclerosis), and reparative dentin which is responsible for biologic and pathologic stimuli. The pulp tissue with its circulation extending into the tubular dentin keeps the dentin supple, moist, and resilient; these characteristics, in turn, assure protective resistance to the forces of mastication. Without a pulp, all these functions cease [3]. Historically, the first pulp capping procedure was performed in 1756, by Phillip pfaff, who packed a small piece of gold over an exposed vital pulp to promote healing. The success of the

pulp capping procedure greatly depends upon the circumstances under which it is performed and the prognosis depends upon the age, type, site and size of pulp exposure [4]. Pulp exposure can lead to several consequences which could result in pain or infection. Pulp exposure often requires endodontic treatment and restoration or extraction.

An alternative to this procedure is pulp capping, in which a medicament is placed directly over the exposed pulp (direct pulp cap), or a cavity liner or sealer is placed over residual caries (indirect pulp cap) in an attempt to maintain pulp vitality and avoid the more extensive treatment dictated by extraction or endodontic therapy [5]. Direct pulp capping, is in which a material is placed directly over the exposed pulp tissue, this has been suggested as a way to promote pulp healing and generate reparative dentin [6]. Direct pulp capping is used when the pulp is visibly exposed due

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Received: November 05, 2020

Accepted: November 18, 2020

Published: November 24, 2020

Citation: Westeous Dominic Pereira, Deepak S, Surendar S. Association between Type Of Pulp Capping and Materials used in University Hospital. *Int J Dentistry Oral Sci.* 2020;S10:02:007:38-43. doi: <http://dx.doi.org/10.19070/2377-8075-S102-010007>

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to caries, trauma, or iatrogenic insult such as accidental exposure during tooth preparation or caries removal. The procedure typically involves arresting any pulpal hemorrhage followed by covering and sealing exposed pulp tissue in some fashion to preserve its health, function, and viability. In indirect pulp capping the infected and affected dentin is removed without exposing the pulp in a vital, healthy tooth this is followed by the placement of a medicament (calcium hydroxide or a bioactive material) in order to promote the formation of tertiary dentin [7].

The ultimate objectives of any pulp capping procedure should be to manage bacteria, arrest any residual caries progression, stimulate pulp cells to form new dentin, and provide a biocompatible and durable seal that protects the pulp complex from bacteria and noxious agents [7].

A variety of materials have been suggested for pulp capping [8]. Some pulp capping materials also help in the formation of dentin bridges. Dentin bridge is defined as a deposit of reparative dentin or other calcific substances that forms across and resells exposed tooth pulp tissue [9]. Direct pulp capping agents like calcium hydroxide and MTA help in thick dentin bridge formation [10].

Indirect pulp capping is procedures taken to protect or maintain the vitality of the carious tooth that, if completely excavated, the decay would result in a pulp exposure [11, 12]. In 1938, Bodecker introduced the Stepwise Caries Excavation (SWE) Technique for treatment of teeth with deep caries for preservation of Pulp vitality [13]. Common materials used for indirect pulp capping include calcium hydroxide, MTA, Biodentine etc.

Calcium hydroxide is a gold standard of direct pulp material discovered in 1929. Calcium hydroxide is believed to effect pulp repair by one or more of several mechanisms of action. It has been believed that hydroxide's high pH causes irritation of the pulp tissue, which stimulates repair via some unknown mechanism [14]. Mineral Trioxide Aggregate (MTA) has been emerging as a good direct pulp capping agent in recent years [15]. MTA is used more commonly next to calcium hydroxide due to its good compatibility, less pulpal inflammation, radiopacity and antibacterial property [16]. Calcium phosphate is another pulp capping agent, dentin bridge formation without any tissue necrosis. It has good physical properties; the absence of pulp inflammation is seen when compared to calcium hydroxide $\text{Ca}(\text{OH})_2$. Hydroxyapatite is a ceramic biomaterial, biocompatible, osteoconduction and classified as a ceramic composed of calcium phosphate crystals that are similar to the mineral portion of the bone tissue [17]. RMGIC is also used as pulp capping agents, which provides an excellent bacterial seal and good biocompatibility when used in close approximation but not in direct contact with the pulp. RMGIC as a direct pulp capping agent exhibited chronic inflammation and lack of dentin bridge formation; whereas the calcium hydroxide control groups showed significantly better pulpal healing [18].

In children, according to the guidelines of the American Academy of Pediatric Dentistry (AAPD), indirect pulp treatment is a procedure recommended for teeth with deep carious lesions without signs or symptoms of pulp degeneration. The main goal of this minimal intervention approach is based on modification of the microenvironment of the contaminated dentin, intentionally left under the restoration, thereby arresting the cariogenic process, while preserving the tooth structure and pulp vitality. Further-

more, indirect pulp treatment is preferable to pulpotomy, because the former has shown higher rates of clinical and radiographic success.

New pulp capping techniques may stimulate pulp healing without toxic chemical effects, thus providing better results than $\text{Ca}(\text{OH})_2$. Dentin adhesive systems have been investigated in humans and animals as potential direct pulp capping materials because of their superior ability to adhere to demineralized dentin tissues. Hybridization of dentin bonding and diffusion of adhesives into the dentin tubules may protect the dentin against bacterial leakage and thereby reduce secondary pulpal inflammation. Studies that compared the pulp response to dentin adhesive systems and $\text{Ca}(\text{OH})_2$ showed that adhesive systems did not significantly differ from $\text{Ca}(\text{OH})_2$, in most cases did not result in inflammation, and also induced dentin bridge formation [19]. Recent advances in pulp capping agents include Corticosteroids and Antibiotics, corticosteroids like hydrocortisone, Cleocin, cortisone, Ledermix (calcium hydroxide plus prednisolone), penicillin, neomycin and Keflin (cephalothin sodium) along with calcium hydroxide was used for pulp capping with the thought of reducing or preventing pulp inflammation [20]. Bonding Agents, according to Miyakoshi et al-META-MMA-TBB adhesives and hybridizing dentin bonding agents provide superior adhesion to peripheral hard tissues and effective seal against micro leakage [21]. Lasers Melcer et al., suggested between the years 1985 and 1987 that the carbon dioxide (CO_2) (1W) laser used for direct pulp capping [22].

A successful pulp cap has a vital pulp and a dentin bridge within 75 to 90 days. The major causes of postoperative inflammation and pulp necrosis are non-sterile procedures and bacterial micro-infiltration of the pulp via dentinal tubules [23]. These may result from contamination of an exposed pulp prior to or during cavity preparation, or as a result of improper sealing of the entire dentin substrate interface when placing the restoration. To decrease the chances of contamination the rubber dam either must be in place from the start of the restorative procedure or be placed once a pulp exposure has been recognized.

Previously our team had conducted numerous studies which included in vitro studies. [24-29], review [30-33], survey [34, 35], clinical trials [36-38]. Now we are focussing on retrospective studies, the aim of this study is to assess and compare the association between types of pulp capping & materials used in Chennai.

Materials and Methods

Study design and setting

This pilot retrospective study examined the records of 86000 patients from June 2019 - March 2020. Non - Probability sampling was done.

Ethical Approval

Ethical approval was obtained from the institutional Ethics Committee.

Ethical Approval Number SDC/SIHEC/2020/DIASDA-TA/0619-0320.

Inclusion Criteria

Patients of all age groups who underwent direct or indirect pulp capping.

Exclusion Criteria

Patients who have not undergone deep caries management were excluded from this study.

Data Collection

Patient records were reviewed, analysed and were used to identify the patients who underwent pulp capping. Relevant data such as age, sex and treatment done was recorded. Repeated patient records and incomplete records were excluded. Data was verified by an external reviewer.

Statistical Analysis

Data was recorded in Microsoft Excel 2016 and later exported to IBM SPSS (version 20.0 Chicago, USA) and subjected to statistical analysis. Chi square test was employed with a level of significance set at $p < 0.05$.

The statistical analysis between type of pulp capping and materials used was carried out in SPSS software. Chi square test was done to compare the parameters. The outcome data was represented in the form of bar graphs.

Results and Discussion

A total of 426 patients were examined, the patients were categorized in different age groups ranging from (1-80 years). The

mean age was 23.77 years. Majority of patients were seen in the age group 20-30yrs - 28.6% (n=122) followed by 1-10 yrs 24.1% (n=103). The least amount of patients were seen above the age group 60 yrs [Figure 1].

Majority of patients who underwent pulp capping were Males 59.9% (n=255), followed by the female patients. 40.1% (n=171) [Figure 2].

The type of pulp capping was divided into direct or indirect pulp capping. There was an increase in the patients who underwent direct pulp capping 69.2% (n=295), followed by indirect pulp capping 30.8% (n=131) [Figure 3].

Pulp capping agents were categorized as MTA, Ca(OH)_2 , RMGIC. The most common material used for pulp capping was Ca(OH)_2 82.2% (n=347), followed by RMGIC 10.9% (n=46) and the least used material was MTA 6.9% (n=29) [Figure 4].

In comparison with pulp capping agent used and type of pulp capping material used Ca(OH)_2 55.92% (n=236) was the most commonly used material for direct pulp capping followed by RMGIC 7.58% (n=32), the least used material was MTA 5.45% (n=23) [Figure 5].

The most frequently used pulp capping agent for indirect capping was Ca(OH)_2 26.3% (n=111), followed by RMGIC 3.32% (n=14) & the least used material was MTA 1.42% (n=6) [Figure 5]. Chi-square test showed the value - 0.424 which was statistically insignificant. ($p > 0.05$)

The data for this retrospective study was based on residents of Chennai. Since all data available was included without a sorting

Figure 1. Bar chart depicting the distribution of age and number of patients underwent pulp capping. X-axis represents distribution of age & Y axis represents the number of teeth undergone pulp capping. Majority of teeth that underwent pulp capping were seen between the age group 20-30y followed by 1-10y the least was 70-80 y.

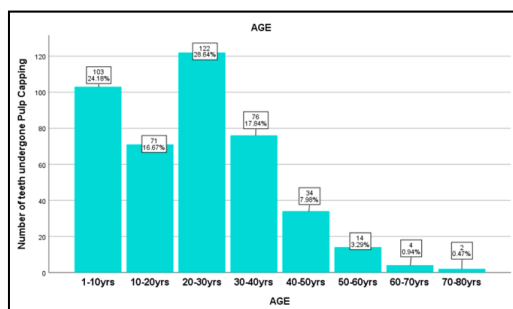


Figure 2. Bar chart depicting the distribution of gender and number of patients undergone pulp capping. X-axis represents the distribution of gender and Y axis represents the number of teeth undergone pulp capping. Males who had undergone pulp capping were 59.9%, followed by the females 40.1%. This shows that males had undergone more pulp capping procedures when compared to females.

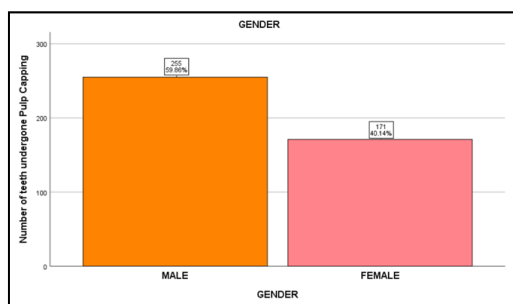


Figure 3. Bar chart depicting the type of pulp capping and total number of patients undergone pulp capping. X-axis represents the type of Pulp Capping and Y axis represents the number of teeth undergone pulp capping. The teeth which had undergone direct pulp capping was 69.2%, followed by indirect pulp capping 30.8%. This shows that direct pulp capping was performed more when compared to indirect pulp capping.

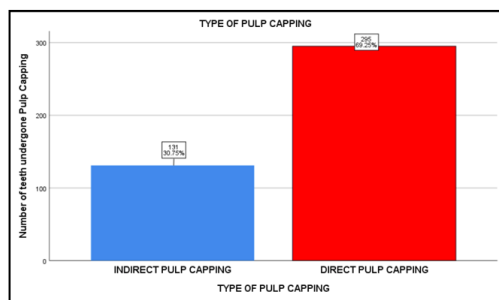


Figure 4. Bar chart depicting the distribution of materials used for pulp capping and total number of patients undergone pulp capping. X-axis represents the type of pulp capping & Y axis represents the number of teeth undergone pulp capping. The most common material used was Ca(OH)₂ 82.2%, followed by RMGIC 10.9% and the least used material was MTA 6.9%. This shows that Ca(OH)₂ was the commonly used material for pulp capping.

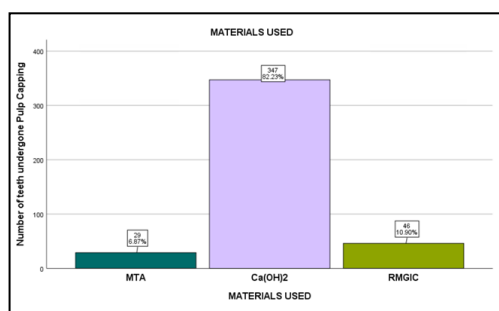
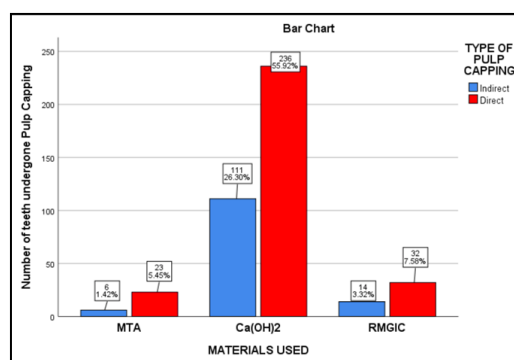


Figure 5. Bar chart depicting the association between type of pulp capping and material used for pulp capping. X-axis represents the distribution of type of pulp capping and the materials used. Y axis represents the number of teeth undergone pulp capping. Ca(OH)₂ 55.92% was the most commonly used material for direct pulp capping followed by RMGIC 7.58%, the least used material was MTA 5.45%. The most frequently used pulp capping agent for indirect capping was Ca(OH)₂ 26.3%, followed by RMGIC 3.32% & the least used material was MTA 1.42%. This shows Ca(OH)₂ that was the most commonly used material for direct pulp capping. Chi-square test showed the value P=0.424 which was statistically not significant. (p>0.05). Which shows no association between the type of pulp capping and the material used.



process, no bias was expected in selection of patients. The current study aims to assess the association of types of pulp capping and materials used.

Pulp capping is an alternative to endodontics treatment or extraction. Various materials have been used for both direct and indirect pulp capping. Calcium hydroxide has been considered as the gold standard of pulp capping. Calcium hydroxide has the ability to dissociate into calcium and hydroxyl ions, its high pH, antibacterial properties, and apparent ability to stimulate odontoblasts and other pulp cells in various ways to form reparative dentin. Studies have also shown that the high pH of calcium hydroxide causes superficial coagulation necrosis where it contacts the pulp

[39]. MTA had significantly better sealing abilities than conventional endodontic materials when used as a root end sealer and in the repair of furcation and lateral root perforations. MTA has several other positive attributes, including high biocompatibility, bioactivity, hydrophilicity, radiopacity, less toxicity than calcium hydroxide, and good sealing ability. MTA has been shown to promote regeneration of the periodontal ligament, dental pulp, and periradicular tissues [40]. MTA can form a thicker dentin bridge compared with traditional gold standard pulp capping material calcium hydroxide, although there is no evidence to prove the dentin thickness aid in the success rate of pulp capping. While some studies showed that calcium hydroxide performed as well as MTA [41]. The success rate of the restoration depended on vari-

ous factors like age of the patient, type of material used [42, 43].

In the current study, the majority of pulp capping was carried out in the age group 20-30yrs followed by 10-20 years. In a study conducted by Mente, J et al, the majority of the patients who underwent pulp capping were under the age group 30-50 years [44]. Hilton et al, proposed in his study the increase in the number of patients undergoing pulp capping treatment of age more than 25yrs [45]. Poor oral hygiene behaviours among older adults, which leads to decay-causing bacteria come into contact with sugars and starches from foods and drinks.

Here was an increase in the number of males who underwent pulp capping when compared to females. The study conducted by Mente, J showed an increase in the number of pulp capping performed in females when compared to males [44]. Hilton also proposed an increase in the number of female patients when compared to males [45]. The possible reason being higher caries among females that is often due to earlier eruption of teeth in women, hence longer exposure of women teeth to the cariogenic oral environment, easier access to food supplies by women and frequent snacking during food preparation, and pregnancy.

The majority of the patients underwent direct pulp capping when compared to indirect pulp capping. The choice of material for pulp capping was $\text{Ca}(\text{OH})_2$, followed by RMGIC. Previous study done by Hilton et al, the commonly used pulp capping agent was $\text{Ca}(\text{OH})_2$ [45]. Similar study done by Haskell et al also stated the increase in the usage of $\text{Ca}(\text{OH})_2$ as the pulp capping agent.

In the study done by Brizuela et al, also there increased usage of $\text{Ca}(\text{OH})_2$ as pulp capping material [46]. Calcium hydroxide is a high-alkaline (pH = 11), white, crystalline, slightly soluble basic salt that dissociates into calcium and hydroxyl ions in solution. The advantages of calcium hydroxide are; it has excellent antibacterial properties to eliminate bacterial penetration to the pulp. Induction of mineralization is seen in calcium hydroxide [47]. Cytotoxicity is low in calcium hydroxide [48]. However the risk of pulp inflammation is more in calcium hydroxide.

The tooth that underwent the most number of pulp capping was 46 followed by 36. Study conducted by Brizuela stated that the tooth most affected was the mandibular molars [46]. The possible reason being poor oral hygiene practices & the protection by the tongue and the opening of major salivary ducts present in the mandibular arch has been advanced as a reason for this resistance to caries, but the opening of the parotid glands near the upper molar teeth has failed to give these teeth similar protection, which requires further investigation [49].

The limitation of this study was that it included a relatively smaller population. The success rate of the restoration has not been able to be evaluated. A relatively larger number of the population has to be assessed for attaining a clear protocol for the success rate of pulp capping. The restorative material has to be assessed on the basis of biocompatible nature, sealing ability & adhesiveness to the teeth.

Conclusion

Within the limitation of the current study, the majority of pulp

capping was seen in the age group of 20-30yrs, males underwent more pulp capping treatment when compared to females. $\text{Ca}(\text{OH})_2$ was the commonly used material for both direct & indirect pulp capping. However, there was no significant association between type of pulp capping and materials used in Chennai.

Clinical Significance

Our present study reveals that Calcium hydroxide was the commonly used pulp capping agent in both direct and indirect pulp capping, this helps in the formation of a dentine bridge which prevents invasion of bacteria and keeps the pulp stable. MTA, Biodentine, Endocem, and RetroMTA, have shown to be more effective than $\text{Ca}(\text{OH})_2$ for regeneration of the pulp-dentin complex with limited inflammation. Despite the superior effectiveness of MTA, Biodentine and Endocem, cost could be a determining factor of patient's preference of Calcium Hydroxide over other pulp capping agents.

Acknowledgement

With sincere gratitude, we acknowledge the staff members of the Department of Conservative Dentistry and Endodontics, Saveetha Dental college and study participants for the extended support towards the completion of the research.

Author Contribution

Westeous Dominic Pereira, contributed in concept, acquisition of data analysis, interpretation of data and also drafting the article and revising it critically for important intellectual content and manuscript preparation. Deepak. S, contributed in study design, correction, alignment, preparation of manuscript and supervision. Surendar S, contributed to alignment and formatting and final approval of the submitted version of the manuscript.

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