



Knowledge, attitude and practise of usage of MTA and bio dentine as direct pulp capping agents - A questionnaire study

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ABSTRACT



Direct pulp-capping is a procedure in which exposed vital pulp is treated by placing a dental material over dental pulp to maintain vitality and to facilitate reparative dentin formation. The most commonly used pulp-capping material for decades is calcium hydroxide. But due to a number of disadvantages, there is a need for an alternate ideal pulp capping material. Recently MTA and Biodentine have been suggested as promising candidates for use in direct pulp capping procedures. The aim of the present study is to evaluate the knowledge, attitude and practise of usage of MTA and biodentine as direct pulp capping agents. An online questionnaire consisting of 15 questions which included demographic details, and questions regarding their knowledge and awareness of direct pulp therapy and the properties of MTA and biodentine. Data was collected from filled questionnaires and analysed using SPSS software. Majority of the respondents (40.1%) chose calcium hydroxide as the material of choice for direct pulp capping and only 30% of the study population chose both MTA and biodentine as a direct pulp capping agent, which was statistically significant ($p=0.000$). 52% of the respondents were not aware of the major drawbacks of MTA. Knowledge regarding properties of biodentine in comparison to MTA was higher. Within the limits of the study, it shows that the knowledge in regard to the use of MTA and biodentine as direct pulp capping was poor despite recent studies showing a growing number of advantages over calcium hydroxide.

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INTRODUCTION

The concern in placing a pulp capping material on such cases of cariously exposed pulp is because of incompetence in identifying a dental material that is reliable, nonabsorbable, bioactive along with a predictable outcome. The choice of dental material determines the prognosis of vital pulp therapy. Studies have experimented with several materials for capping vital pulp. Although calcium hydroxide has long been used for pulp capping as the material of choice, it has a number of disadvantages, like

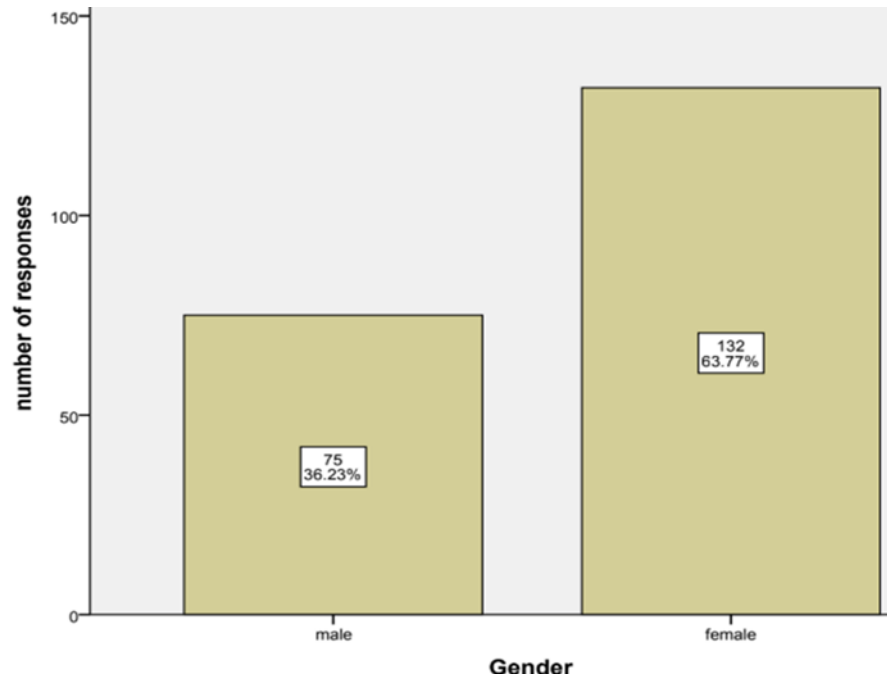


Figure 1: Bar chart represents frequency distribution of respondents based on gender

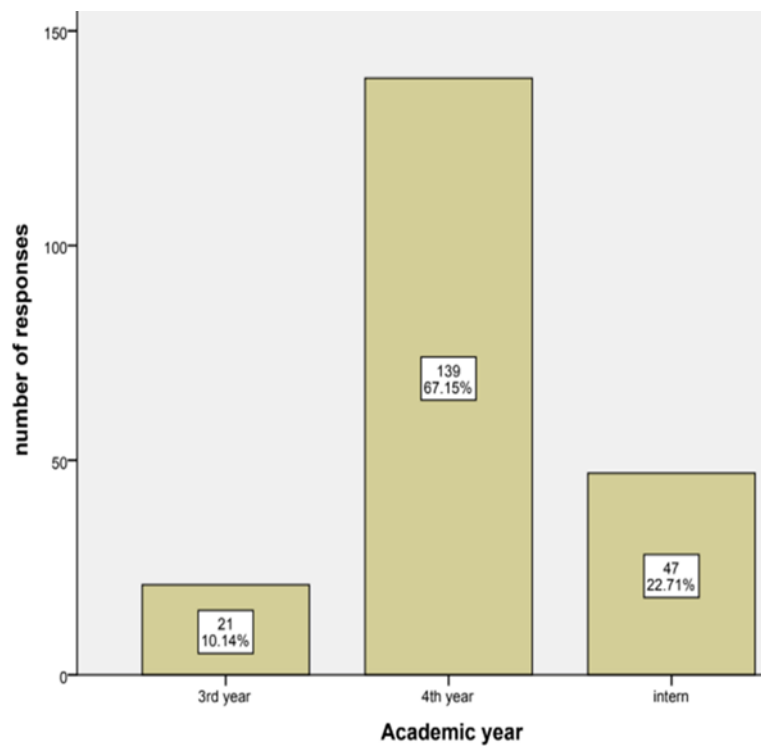


Figure 2: Bar chart representing the frequency distribution of responses based on academic year

insufficient adherence to dentin, dissolution of the material with time and dentin bridges with multiple tunnel defects (Seltzer *et al.*, 1963). Calcium hydroxide suspensions have been found to cause liquefaction necrosis of the pulpal tissue at the surface due to its high pH (12.5) (Hörsted-Bindslev *et al.*, 2003). Mineral trioxide aggregate (MTA) is a recommended alternative to calcium hydroxide as it stimulates the formation of dentin-bridge faster, which allows pulp healing and results in high success rates in clinical practice. MTA possesses many properties like biocompatibility, antibacterial activity and is a bioactive material with good stability and outstanding sealing ability. However, some studies show no significant clinical and histological difference in results when MTA and calcium hydroxide were used (Iwamoto, 2006). Nevertheless, it does possess some troubling disadvantages such as prolonged setting time, difficulty in handling, higher material cost and unaesthetic appearance due to discolouration potential, which remain a challenge in clinical practice.

A new calcium-silicate-based restorative cement called Biodentine (Septodont) has been introduced, which has similar applications as that of MTA and can be used as a dentin substitute. It stimulates the vital pulp cells and encourages reparative dentin formation when it is in direct contact with the pulp tissue. Its consistency is quite similar to that of phosphate cement. Biodentine can be directly applied as a bulk dentin substitute in the cavity without the need for preconditioning and it also has a shorter setting time (Mente, 2010). Biodentine has similar indications and mode of action as calcium hydroxide, but it does not share its disadvantages. Therefore, three major disadvantages of calcium hydroxide, which are a higher rate of material resorption, mechanical instability and risk of microleakage are avoided. Biodentine demonstrates mechanical strength, less solubility and a tighter seal.

In comparison to other materials like MTA, Biodentine can be handled with ease and needs much lower time for setting (Hörsted-Bindslev *et al.*, 2003). Biodentine also revealed a significantly more pronounced antibacterial effect in comparison to MTA. MTA has a high initial pH of 10.2 and this rises to 12.5 in 3 hours and this, in turn, attributes to the antimicrobial action of MTA. Biodentine possesses significantly higher push-out bond strength after 24 hours setting time than MTA. However, after 7 days in uncontaminated samples, MTA and biodentine demonstrated almost similar push-out bond strength. Contamination by blood, irrespective of the duration of setting time, had no effect on the

push-out bond strength of Biodentine. One major advantage of biodentine over MTA is that it can be easily manipulated due to its high viscosity and also its much shorter setting time (Deshmukh *et al.*, 2018).

Favourable results have been demonstrated by both MTA and biodentine when used as direct pulp capping materials in mechanically exposed pulps (Nowicka, 2013). However, clinical literature comparing biodentine and MTA as direct pulp capping agents in carious teeth is limited. Previously our team had conducted numerous clinical trials (Ramamoorthi *et al.*, 2015; Hussainy, 2018) as well as reviews (Noor and Pradeep, 2016; Kumar and Antony, 2018; Ravinthar and Jayalakshmi, 2018; Rajakeerthi and Nivedhitha, 2019; Teja and Ramesh, 2019) and surveys (Manohar and Sharma, 2018; Jose *et al.*, 2020) and in-vitro studies (Ramanathan and Solete, 2015; Nasim and Nandakumar, 2018; Ramesh *et al.*, 2018; Rajendran, 2019; Siddique, 2019; Janani *et al.*, 2020) over the past 5 years. Now we are focussing on epidemiological surveys. The idea for this survey stemmed from the current interest in our community. Hence, the aim of the study was to evaluate the knowledge and awareness of dentists in the usage of MTA and biodentine indirect pulp capping of carious teeth.

MATERIALS AND METHODS

This was an online questionnaire-based study which was conducted among the undergraduate students from a private dental college (SIMATS) in Chennai during May 2020. The approval of this present study was obtained from the Institutional Ethics Committee. The study included students who were willing to participate in this questionnaire study. A pre-designed validated questionnaire consisting of 15 questions which included demographic details, and questions regarding their knowledge and awareness about the usage of MTA and Biodentine as direct pulp capping agents was employed.

First part of the questionnaire was regarding the demographic details of the study participant such as age, gender and year of the study. The second part consisted of 12 questions on knowledge regarding management of deep carious lesions, properties of biodentine and MTA, advantages and disadvantages of each material and material of choice for direct pulp capping. The data was collected from the filled questionnaires and was entered in Microsoft Excel spreadsheet. The statistical program SPSS was used for data management and analysis. Descriptive statistics were computed. The frequency for each domain, such as knowledge, attitude, and practice

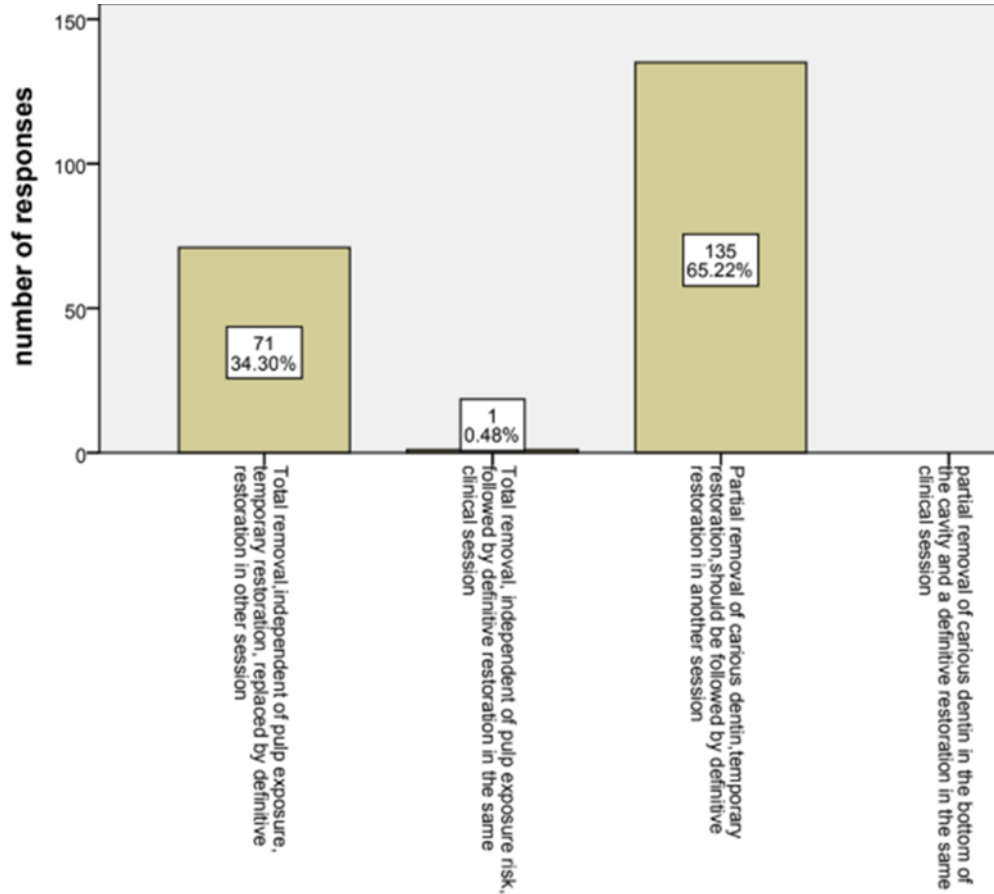


Figure 3: Bar chart representing the frequency distribution of responses to the question “In cases of deep decay lesion when pulp proximity is present, what would be your option to treat this lesion”

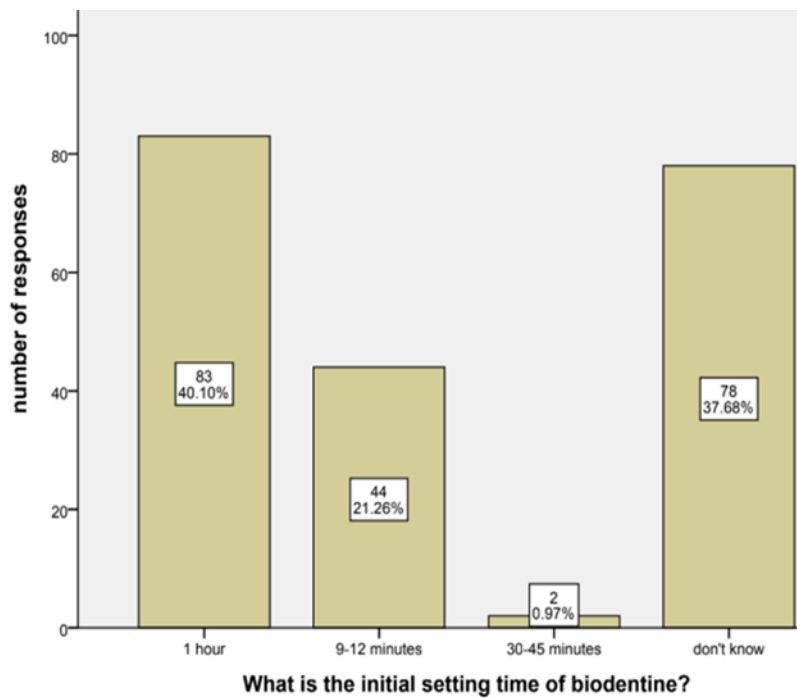


Figure 4: Bar chart representing the frequency distribution of responses to the question “the initial setting time of Biodentine”

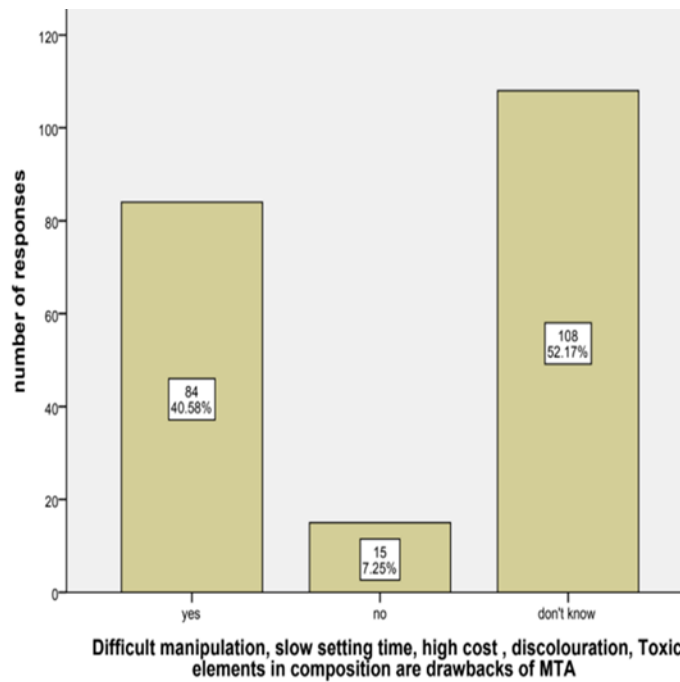


Figure 5: Bar chart representing the frequency distribution of responses to the statement “Difficult manipulation, slow setting time, high cost, discolouration, toxic elements in composition are drawbacks of MTA”

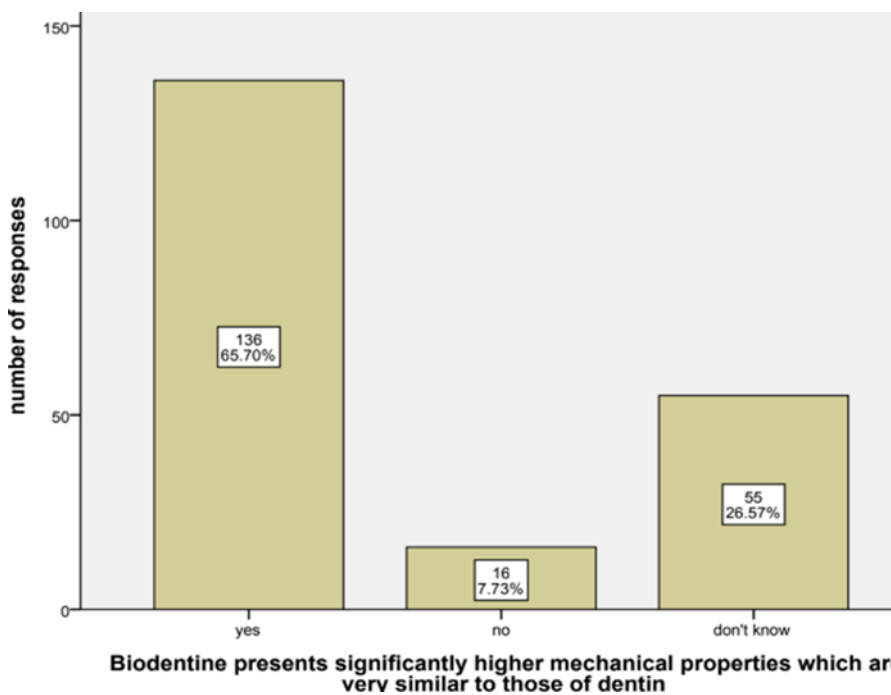


Figure 6: Bar chart representing the frequency distribution of responses to the statement “Biodentine presents significantly higher mechanical properties which are very similar to those of dentin”

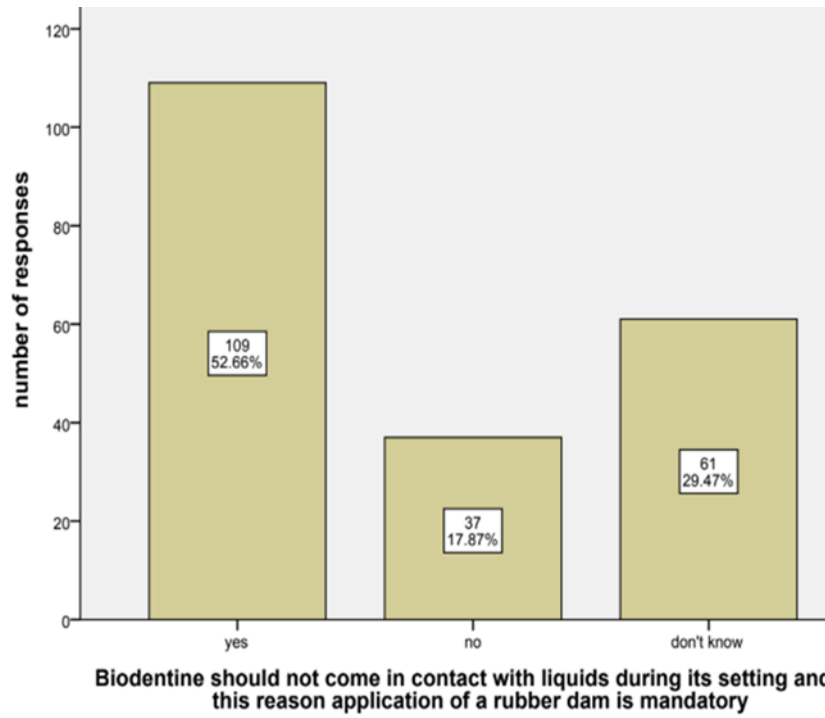


Figure 7: Bar chart representing the frequency distribution of responses to the statement “Biodentine should not come in contact with liquids during its setting and for this reason application of a rubber dam is mandatory”

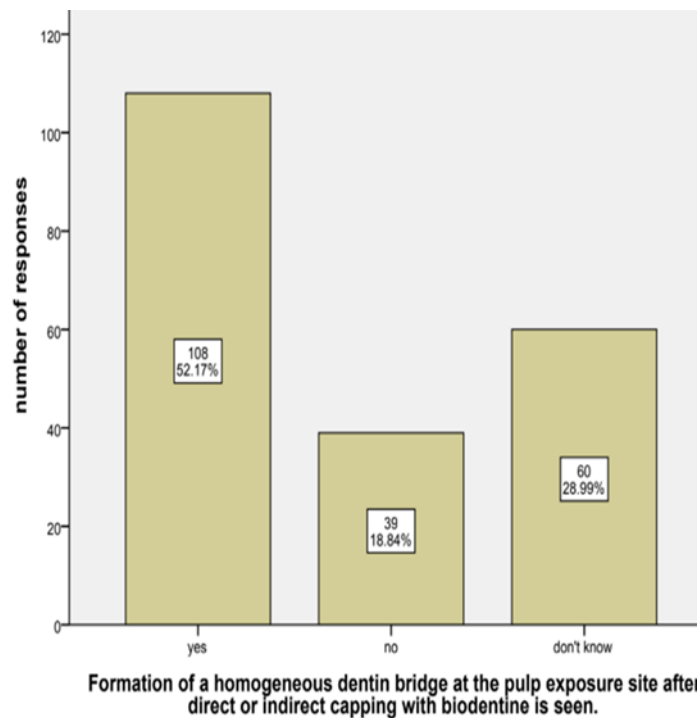


Figure 8: Bar chart representing the frequency distribution of responses to the statement “Formation of a homogeneous dentin bridge at the pulp exposure site after direct or indirect capping with biodentine is seen”

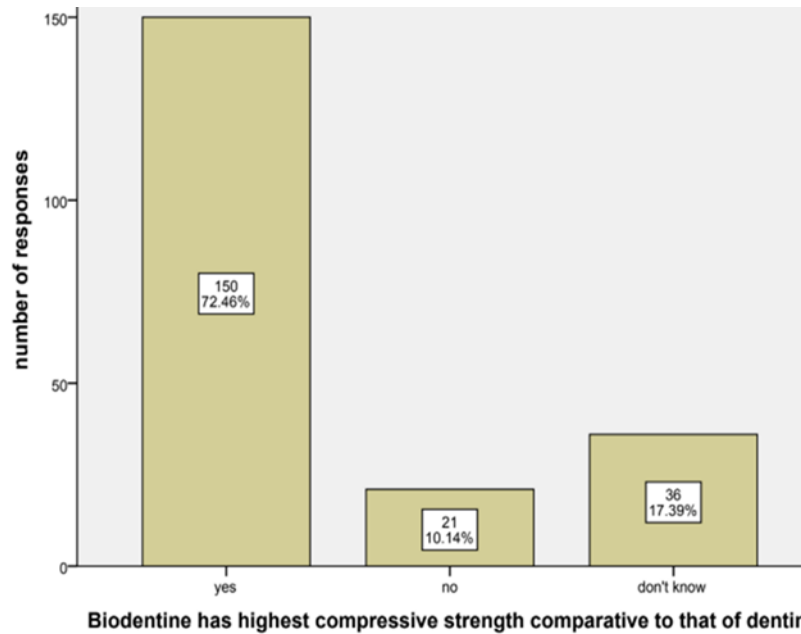


Figure 9: Bar chart representing the frequency distribution of responses to the statement "Biodentine has the highest compressive strength comparative to that of dentine"

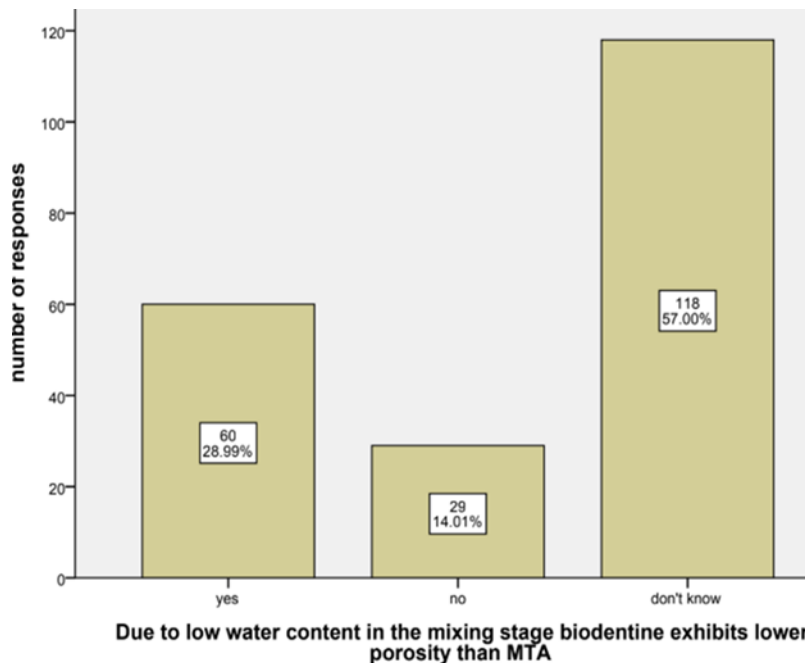


Figure 10: Bar chart representing the frequency distribution of responses to the statement "Due to low water content in the mixing stage biodentine exhibits lower porosity than MTA"

was determined after giving weightage and calculated for each option.

RESULTS AND DISCUSSION

A total of 207 students participated in this study and the response rate was 63.8% (106/138) among female students and 36.2% (32/138) among male students (Figure 1). Distribution of participants based on the academic year is represented in Fig-

ure 2. A majority of the population (65.22%) preferred partial removal of carious dentin followed by temporary restoration, and definitive restoration in another clinical session in case of the deep carious lesion and 34.3% of the population preferred complete excavation of the carious lesion independent of risking pulpal exposure (Figure 3). Only 21.26% of the study population knew that the initial setting time of biodentine was 9-12 minutes (Figure 4). 52.17% were unaware of the major disad-

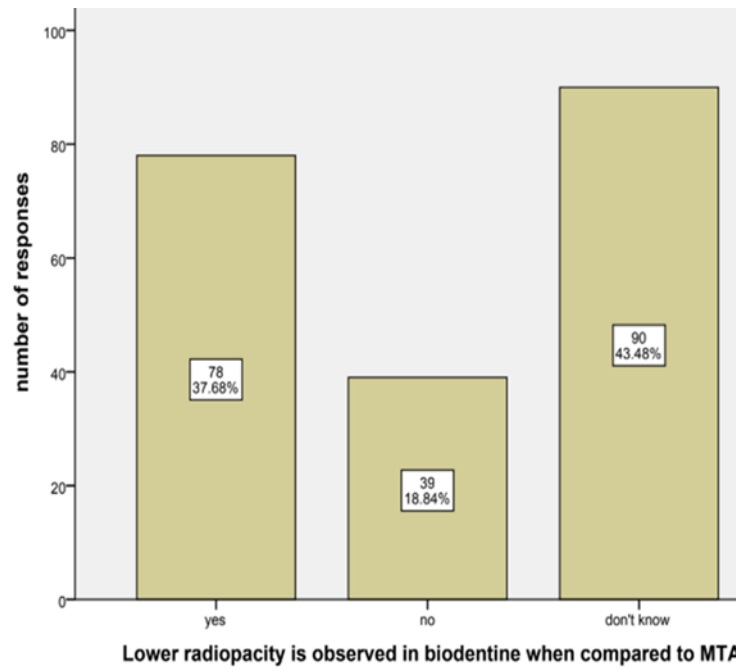


Figure 11: Bar chart representing the frequency distribution of responses to the statement “Lower radiopacity is observed in biodentine when compared to MTA”

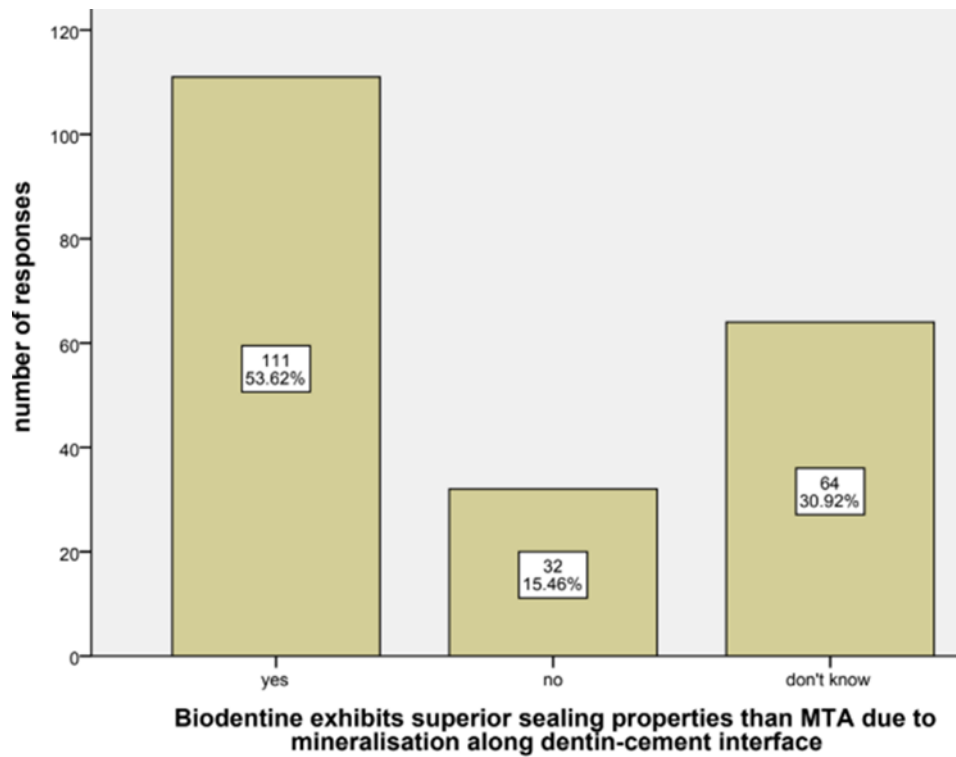


Figure 12: Bar chart representing the frequency distribution of responses to the statement “Biodentine exhibits superior sealing properties than MTA due to mineralisation along dentin-cement interface”

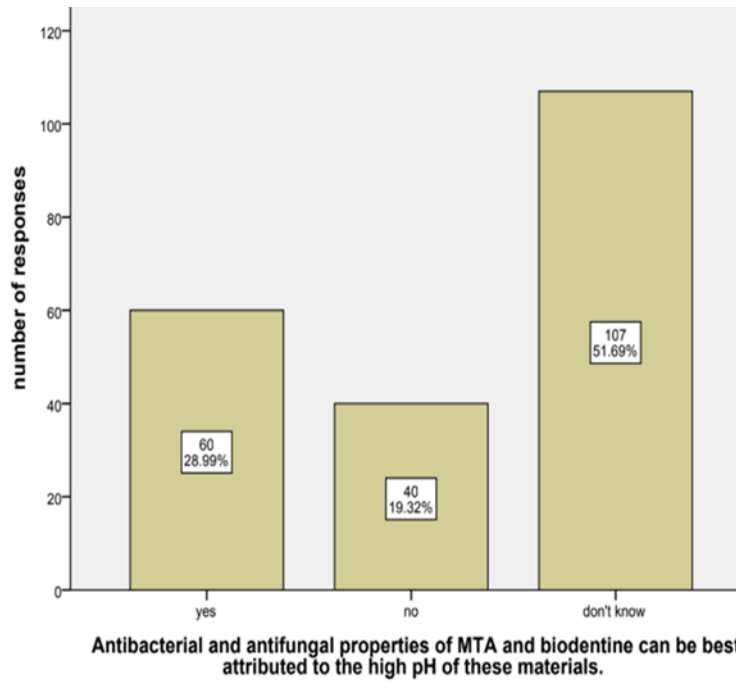


Figure 13: Bar chart representing the frequency distribution of responses to the statement “Antibacterial and antifungal properties of MTA and biodentine can be best attributed to the high pH of these materials”

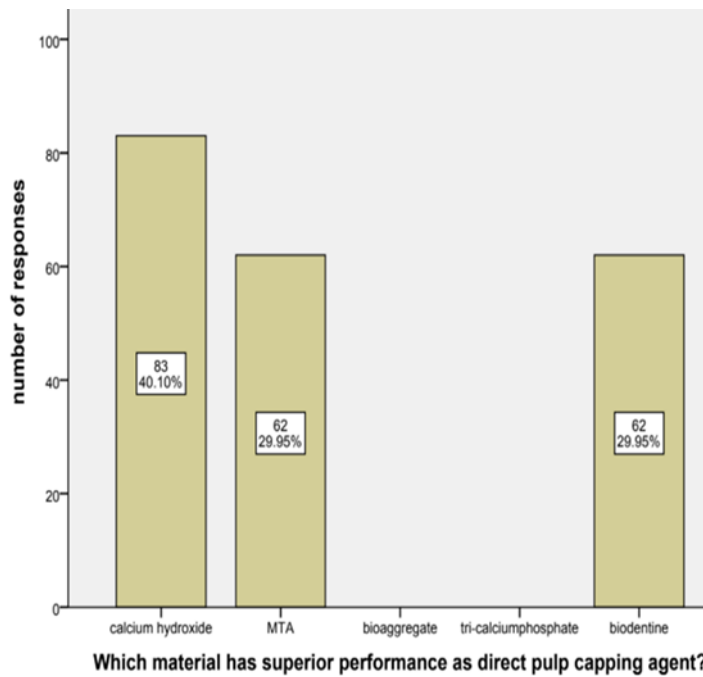


Figure 14: Bar chart representing the frequency distribution of responses to the question “Which material has superior performance as direct pulp capping agent”

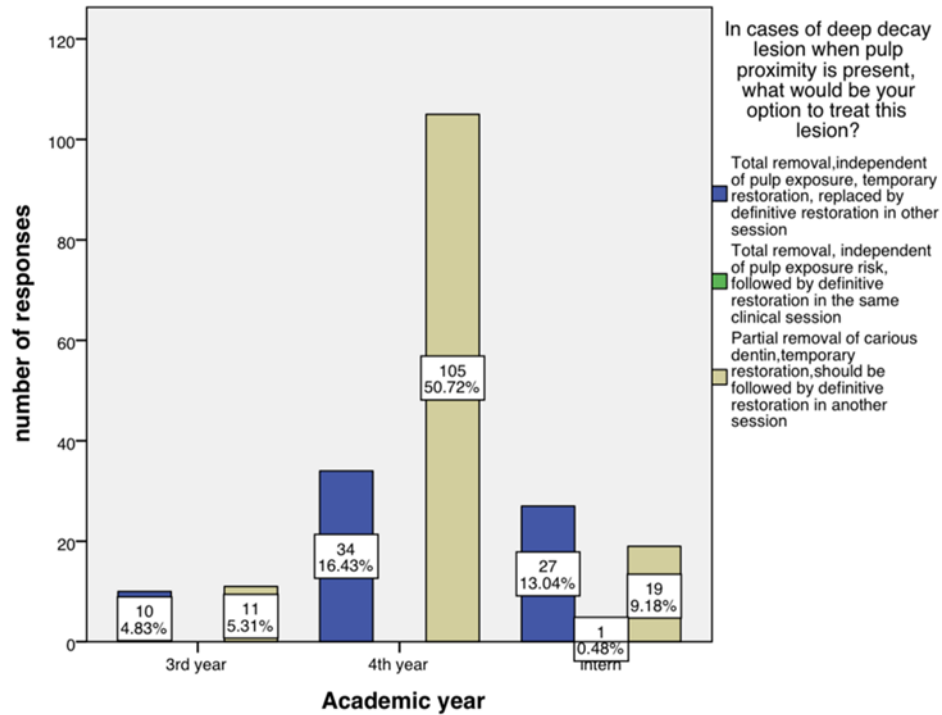


Figure 15: Bar graph representing association of responses based on academic year to the question “In cases of deep decay lesion when pulp proximity is present, what would be your option to treat this lesion”

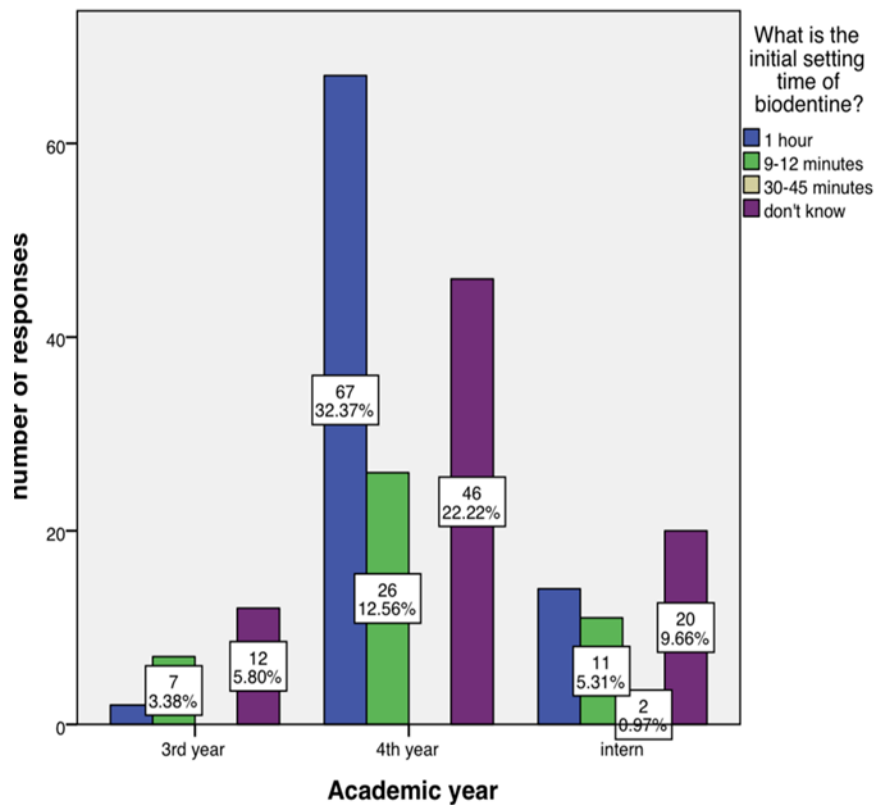


Figure 16: Bar graph representing association of responses based on academic year to the question “what is the initial setting time of biodentine”

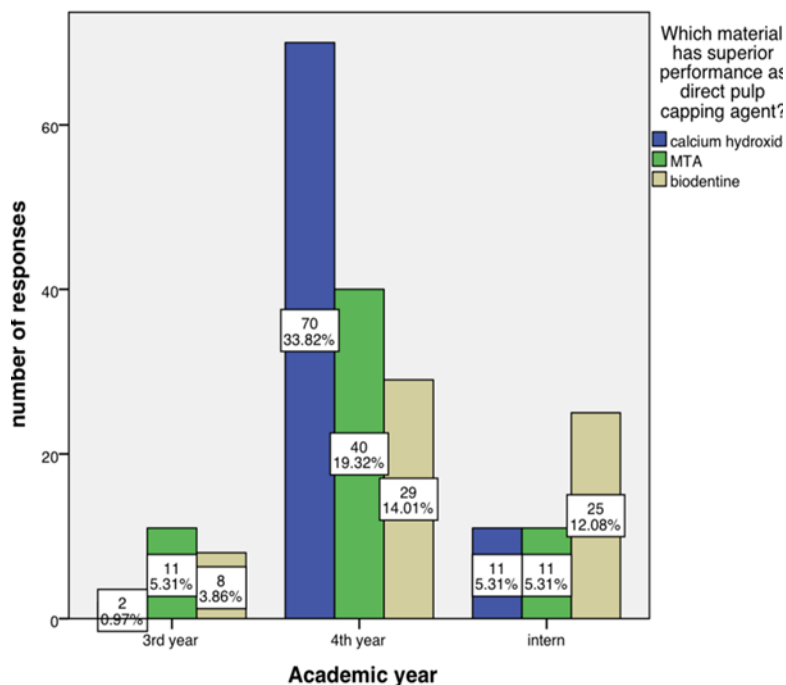


Figure 17: Bar graph representing association of responses based on academic year to the question “Which material has superior performance as direct pulp capping agent”

vantages of MTA (Figure 5). 65.7% of the study participants agreed that biodentine presented significantly higher mechanical properties similar to that of dentin (Figure 6). Almost half the population (52.66%) were aware that rubber dams are necessary as biodentine should not come in contact with liquids (Figure 7). Majority of the participants agreed that the formation of a homogeneous dentin bridge at the pulp exposure site after direct or indirect capping with biodentine is seen (52.17%) (Figure 8). Majority of the participants agreed that biodentine has the highest compressive strength comparative to that of dentine (72.46%) (Figure 9). Only a small amount of the population was aware that biodentine had lower porosity (28.99%) (Figure 10) and lower radiopacity (37.68%) (Figure 11) in comparison to MTA. 53.62% felt that biodentine exhibits superior sealing properties than MTA due to mineralisation along with the dentin-cement interface (Figure 12). The majority of the population (51.69%) were unaware that the antimicrobial properties of MTA and biodentine were due to the high pH of these materials (Figure 13). The material preferred as a superior agent for direct pulp capping was calcium hydroxide (40.10%) followed by MTA (29.95%) and biodentine (29.95%) (Figure 14).

On comparison of responses based on year of study, a few significant associations were noticed; Majority of the IV year students chose partial removal followed by definitive restoration in another session (p-value = 0.000) (Figure 15). Majority of the partic-

ipants in IV years chose 1 hour as the initial setting time of biodentine (32.37%) whereas interns and III year participants were unaware of the initial setting time, which was statistically significant (p-value = 0.002) (Figure 16). Majority of the participants in IV years chose calcium hydroxide (33.82%) whereas interns chose biodentine (12.08%) and III year participants chose MTA (5.31%), which was statistically significant (p-value = 0.000) (Figure 17).

More than half the study population (65.2%) preferred partial removal of carious dentin followed by temporary restoration in case of the deep carious lesion (Figure 3) which has a statistically significant association with their academic year of study (Figure 15), showing that students with more academic years of education opted to partially remove deep caries lesion and give a definitive restoration in the next clinical appointment. This result is in accordance with a study conducted among dentists in Brazil, where 61.4% of clinicians also chose to perform partial caries removal (Chisini *et al.*, 2015). MTA, despite being a popular alternative to calcium hydroxide, presents disadvantages such as discolouration, the presence of toxic elements like arsenic, high cytotoxicity when freshly mixed, longer setting time, high pH during setting and overall difficulty in handling. Almost half the study population was unaware of the major disadvantages of MTA. Biodentine has an initial setting time of about 9-12 minutes due to the presence of a setting accelerator which improves its handling properties. This gives

an advantage over MTA (60-70 minutes) because delayed setting time increases the risk of partial material loss and alteration at the interface (Grech *et al.*, 2013). However, a majority of the participants in this study did not know this advantage of biodentine. A critical factor that determines the prognosis is porosity as pore diameter directly corresponds to the amount of leakage which compromises the hermetic seal due to bacterial ingress. Biodentine has lower porosity and superior sealing tendency due to excellent adaptation to the underlying dentin (Kaur, 2017). The mean radiopacity of MTA is said to be 7.17 mm of the equivalent thickness of aluminium and that of biodentine is 3.5 mm of aluminium (Grech *et al.*, 2013). Study participants in the current study were aware of the superior sealing property of biodentine but lacked knowledge regarding the lower porosity and radiopacity.

During the setting reaction of biodentine, its compressive strength increases from 100 MPa (1st hour) to 200 MPa (24th hour) and continues to increase and finally reached 300 MPa in one month due to its lower water content. This is comparable to that of natural dentin and higher than most cements (Grech *et al.*, 2013). A majority of the population were aware of the high compressive strength of biodentine. More than half of the students agreed that biodentine forms a homogenous dentine bridge. Studies show biodentine forms a dentinal bridge of good quality that is uniform, thick and continuous, and also lacks inflammation due to complete seal of the pulp tissue in comparison to calcium hydroxide. Majority of the students knew that non-contact with liquids is necessary, thus making rubber dam mandatory when using biodentine as pulp capping material.

The high pH of MTA and biodentine are responsible for the antibacterial and antifungal properties of these materials. This high alkalinity imparts an inhibitory effect on the microorganism growth and results in disinfection of dentin. However, students in the current study were unaware of the antimicrobial mechanism of these materials. Majority of students chose calcium hydroxide as the superior direct pulp capping agent (Figure 3). This is in accordance with previous studies where the majority chose calcium hydroxide as the material of choice due to reliable results and ease of use, familiarity with technique (Chisini *et al.*, 2015; Stangvaltaite *et al.*, 2017). There is a statistical significance in the association of year of study and preferred material of choice with a preference for MTA and biodentine increasing with the year of study (Figure 17).

CONCLUSION

Within the limitations of this survey, it can be concluded that the participants have an average level of knowledge about vital pulp therapy and the use of MTA and biodentine indirect pulp capping. Inadequate knowledge in some points needs to be addressed and requires more focus. In addition, students need to be educated about current research and recent advancements in the materials available. The lack of awareness regarding the usage of MTA and biodentine for direct pulp capping could be attributed to high cost and lack of training in routine dental facilities. Both materials show promising results and a number of advantages over traditional pulp capping agents like calcium hydroxide and increasing their adoption in clinical practise would prove to be advantageous as they would produce more reliable outcomes.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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