IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 10 Ser. 6 (October. 2025), PP 62-69
www.iosrjournals.org

Awareness And Attitude Of The Usage Of MTA And Bio-Dentine For Pulp Capping Of Deeply Carious Teeth Among Dental Clinicians In Benghazi City.

Mardeia Hamad, Abdelsalam I Elhddad, Hawwa S Beaayou
Lecturer At Department Of Prosthodontic/ Faculty Of Dentistry/ Benghazi University/ Libya.
Assistant Professor At Department Of Dental Technology/ College Of Medical Technology/ Benghazi, Libya.
Assistant Professor At Department Of Dental Public Health And Preventive Dentistry/ Faculty Of Dentistry/ Benghazi University/ Libya.

Abstract
Background and Aims: *A direct pulp capping is the process where bio-compatible materials is applied over dental pulp to preserve its vitality and induce reparative dentine formation. For decades, calcium hydroxide was the most common pulp capping material. However, due to its known disadvantages recent materials have been introduced such as mineral trioxide aggregate (MTA) and Biodentine. This cross-sectional study aimed to assess the knowledge, attitudes of dental clinicians in Benghazi City regarding the use of (MTA) and Biodentine for direct pulp capping in deeply carious teeth.*
Materials and Methods: *A total of 300 questionnaires were distributed to dentists in private clinics, with 220 valid responses collected over four months. Demographic data revealed that 44.1% of participants were aged 31–40 years, with a nearly balanced gender distribution. Years of experience were distributed as follows: less than 5 years (35%), 5–10 years (34.5%), and over 10 years (30.5%).*
Results: *showed that 46.4% of clinicians preferred Biodentine as their first choice for direct pulp capping, compared to 35% favoring MTA, and 18.6% selecting calcium hydroxide. However, 37.3% of participants were unaware of the initial setting time of Biodentine, and 35.5% lacked knowledge about MTA's setting time. Additionally, 46.4% acknowledged drawbacks of MTA, while 50% recognized the necessity of using a rubber dam during Biodentine application. Furthermore, 41.4% were aware of Biodentine's ability to form a homogeneous dentin bridge.*
Conclusions and recommendations: *Statistical analysis revealed no significant association between years of experience and knowledge levels or material preferences, indicating that clinical experience alone does not ensure evidence-based decision-making. these findings highlight a notable gap between clinical practice and scientific awareness, underscoring the need for enhanced continuing education programs, updated academic curricula, and promotion of local research to improve the effective use of bioactive materials in vital pulp therapy.*
Keywords: *Direct pulp capping, indirect pulp capping, Calcium hydroxide, MTA, Biodetine.*

Date of Submission: 20-10-2025 Date of Acceptance: 30-10-2025

I. Introduction

Deep dental caries presents a substantial challenge in clinical dentistry, often leading to pulp exposure and increasing the risk of pulpitis or necrosis if not managed properly.1Preserving pulp vitality is a primary objective in modern restorative dentistry, as it helps maintain the structural integrity and biological function of teeth while reducing the need for invasive root canal treatments.2,3

Pulp capping, whether direct or indirect, is a widely employed technique to preserve pulp vitality and promote dentin bridge formation by sealing the exposed or nearly exposed pulp with biocompatible materials.4,5 Traditionally, calcium hydroxide ($Ca(OH)_2$) has been the material of choice for pulp capping due to its antimicrobial properties and ability to stimulate reparative dentin.6 However, calcium hydroxide exhibits several limitations, including dissolution over time 7, poor mechanical strength, and inadequate bacterial sealing. In addition to the addressed disadvantages, dentinal bridges that have been induced by Ca (OH)2 contained multiple tunnel defects. 8-10

To address these limitations, advanced bioactive materials such as Mineral Trioxide Aggregate (MTA) and Biodentine have been introduced as superior alternatives.11 MTA has shown excellent biocompatibility, sealing ability, and the capacity to stimulate dentinogenesis and tissue repair. 1Controversially, MTA is expensive with hard clinical handling, prolonged setting time. 12-14 Biodentine is recognized as a fast-setting dentin substitute with outstanding biocompatibility, sealing properties, and ease of handling. 15Compared to calcium

hydroxide, Biodentine demonstrated advantages including shorter setting time, higher mechanical strength, and bioactivity that stimulates reparative dentin formation, enhancing pulp preservation. The study concluded that Biodentine is an effective and user-friendly material for pulp capping with promising short-term clinical outcomes, though longer follow-up is recommended for comprehensive evaluation.16 These materials demonstrate promising results in pulp capping procedures, yet their adoption in clinical practice remains inconsistent due to gaps in knowledge, training, and perceived cost barriers among dental practitioners.17

Despite the proven efficacy of MTA and Biodentine, limited data is available on the awareness, attitudes, and clinical practices of dental clinicians regarding their use for pulp capping procedures. Many practitioners continue to depend on conventional materials due to insufficient training, limited exposure, or perceived cost concerns.15

This study is significant as it aims to bridge the gap between evidence-based practices and actual clinical applications. Evaluating dental clinicians' knowledge and practices can highlight deficiencies in training and guide the development of continuing education programs. Such initiatives have the potential to enhance the quality of restorative treatments, reduce the need for invasive procedures, and improve patient outcomes.4

II. Material And Method

Study design

This study employed a cross-sectional observational design utilizing a closed-ended, multiple-choice questionnaire aimed at evaluating the knowledge, attitudes, and practices of dental clinicians, including both general dentists and specialists, in Benghazi city concerning the use of Mineral Trioxide Aggregate (MTA) and Bio-dentine for pulp capping procedures on deeply carious teeth.

Study Location: private dental clinics in Benghazi city, Libya.

Study Duration: March 2025 to July 2025.

Sample size: 300 dental practitioners.

Sample selection and approvals:

A total of 300 questionnaires were distributed randomly across private dental clinics in Benghazi. Out of these, 220 questionnaires were duly completed and returned, constituting the final sample size for the study. The data collection spanned a period of four months. Prior to participation, informed consent was obtained from all dentists to ensure ethical compliance.

Statistical analysis

For data analysis, the responses were entered and processed using SPSS statistical software (version 20). Descriptive statistics, including frequency distributions and percentages, were calculated to summarize the demographic and clinical characteristics of the participants. The results were visually represented through graphs to facilitate interpretation. Subsequently, the Chi-square test was conducted to assess the presence of statistically significant associations between categorical variables, such as clinicians' specialty and their preferences or knowledge regarding the use of MTA and Bio-dentine.

III. Results

A total of 220 questionnaires were duly completed and returned. It is evident from the demographic data table that the percentage of doctors in the age group (1 – 40) years was 44.1%, followed by the age group (20 - 30) years at 37.3%, and 14.5% for the age group (41 – 50) years. The lowest percentage of doctors, 4.1%, was in the age group (51 – 60) years. (Table 1) (Figure 1)

Regarding to the gender distribution there was a close ratio of males and females in the study sample, with 48.2% males and 51.8% females. (Figure 2).

Table no. 1: Shows the distribution of demographic data.

Demographic data			
Characteristic		No.	Percent %
Age Groupe	20 – 30 Years	82	37.3%
	31 – 40 Years	97	44.1%
	41 – 50 Years	32	14.5%
	51 – 60 Years	9	4.1%
Gender	Male	106	48.2%
	Female	114	51.8%
Year of experience	Less than 5 Years	77	35.0%
	5 – 10 Years	76	34.5%
	Over 10 Years	67	30.5%

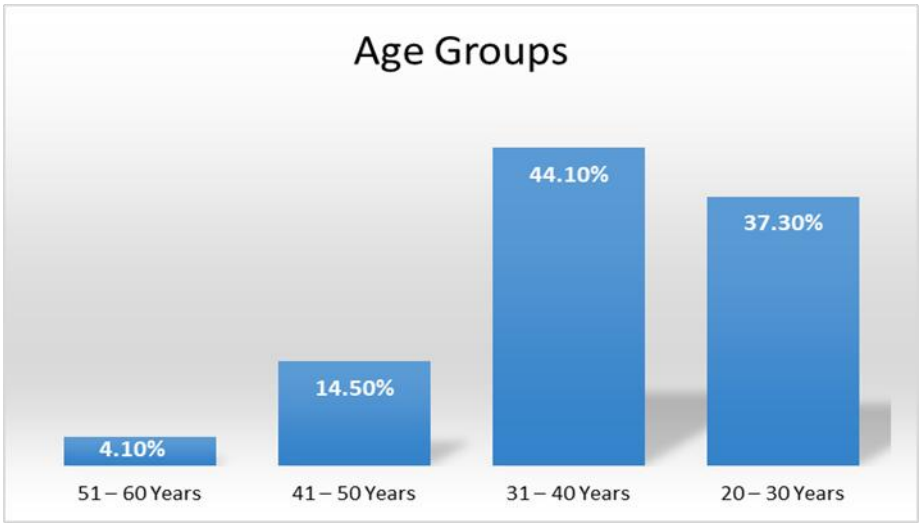

Figure (1) Age of participants.

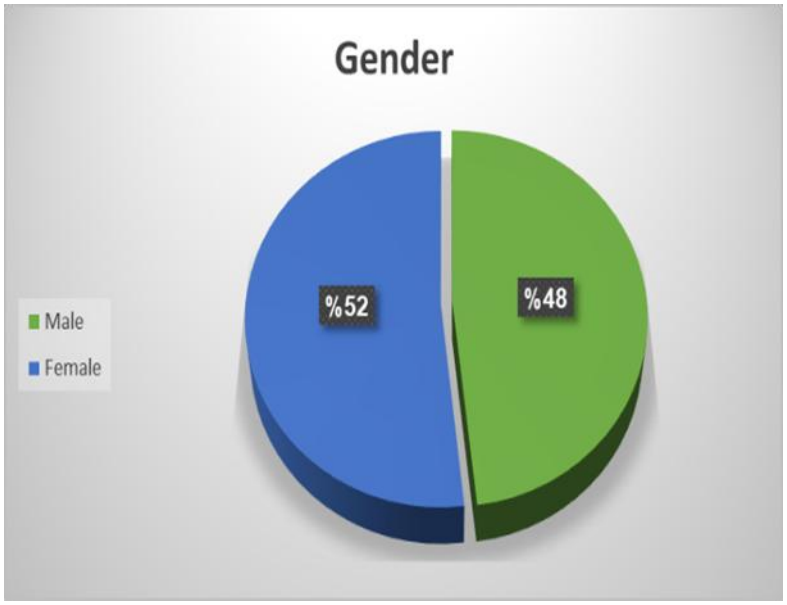

Figure (2) Gender of participants

Finally, the variable of years of experience for the sample of doctors indicates that the highest percentage, 35%, were doctors with less than 5 years of experience, while the percentage of doctors in the 5-10 years' experience category was 34.5%, and the percentage of doctors with more than 10 years of work experience was 30.5%. (Figure 3)

Figure (3) Years of experience of participants

Table no. 2: Shows the cases of deep decay lesions.

Characteristic		**No.**	**Percent %**
1. When pulp proximity is present in cases of deep decay lesion what would be your option to manage this lesion	complete excavation of the carious lesion independent of risking pulpal exposure, temporary restoration followed by definitive restoration in another visit	105	47.7%
	complete excavation of the carious lesion independent of risking pulpal exposure, followed by definitive restoration in the same visit	50	22.7%
	partial excavation of the carious lesion, temporary restoration followed by definitive restoration in another visit	50	22.7%
	partial excavation of the carious lesion followed by definitive restoration in the same visit	15	6.8%
	Total	220	100%

When presenting the case (When pulp proximity is present in cases of deep decay lesion what would be your option to manage this lesion) The highest percentage of doctors' responses were (complete excavation of the carious lesion independent of risking pulpal exposure, temporary restoration followed by definitive restoration in another visit) By 47.7%. (Table 2).

Table no. 3: Shows the answers about material of biodentine and MTA.

Biodentine and MTA			
Characteristic		**No.**	**Percent %**
The initial setting time of Biodentine	9-12 minutes	75	34.1%
	One hours	21	9.5%
	35-40 minutes	42	19.1%
	Do not know	82	37.3%
The initial setting time of MTA	9-12 minutes	47	21.4%
	One hours	62	28.2%
	35-40 minutes	33	15.0%
	Do not know	78	35.5%
Which material has superior performance as direct pulp capping agent	Calcium hydroxide	41	18.6%
	MTA	77	35.0%
	Biodentine	102	46.4%

The table 3 shows the response rates regarding (The initial setting time of Biodentine and MTA). The highest percentage of doctors did not have a clear answer, and When doctors were asked about (Which material has superior performance as direct pulp capping agent), the highest percentage was 46.4% answered Biodentine.

Table no. 4: Shows the questions assessing doctors' knowledge.

Characteristic		No.	Percent %
Difficult manipulation, slow setting time, high cost, dis-coloration, toxic elements in composition are drawbacks of MTA	No	49	22.3%
	Yes	102	46.4%
	Do not know	69	31.4%
Biodentine presents significantly higher mechanical properties which are very similar to those of dentin	No	27	12.3%
	Yes	125	56.8%
	Do not know	68	30.9%
Biodentine should not come in contact with liquids during its setting that is why it is necessary using a rubber dam	No	35	15.9%
	Yes	110	50.0%
	Do not know	75	34.1%
Synthesis of a homogeneous dentin bridge at the pulp exposure site after pulp capping with biodentine is seen	No	44	20.0%
	Yes	91	41.4%
	Do not know	85	38.6%
Biodentine has the highest compressive strength comparative to that of dentine	No	45	20.5%
	Yes	91	41.4%
	Do not know	84	38.2%
Biodentine exhibits lower porosity than MTA because it requires low water content in the mixing stage	No	32	14.5%
	Yes	82	37.3%
	Do not know	106	48.2%
Lower radiopacity is observed in bio dentine when compared to MTA	No	39	17.7%
	Yes	87	39.5%
	Do not know	94	42.7%
Biodentine exhibits superior sealing properties than MTA due to mineralization along dentin-cement interface	No	25	11.4%
	Yes	98	44.5%
	Do not know	97	44.1%
Antibacterial and antifungal properties of MTA and bio dentine may be best related to the high pH of these materials	No	30	13.6%
	Yes	94	42.7%
	Do not know	96	43.6%

Table no. 5: Shows the significant differences in years of experience.

Chi square test					
Characteristics		**Years of experience**			P_ value
		Less than 5 Years No. (%)	5 – 10 Years No. (%)	Over 10 Years No. (%)	
When pulp proximity is present in cases of deep decay lesion what would be your option to manage this lesion	complete excavation of the carious lesion independent of risking pulpal exposure, temporary restoration followed by definitive restoration in another visit	36 (16.4%)	39 (17.7%)	30 (13.6%)	0.157
	complete excavation of the carious lesion independent of risking pulpal exposure, followed directly by definitive restoration in the same visit	16 (7.3%)	18 (8.2%)	16 (7.3%)	
	partial excavation of the carious lesion, temporary restoration followed by definitive restoration in another visit	20 (9.1%)	18 (8.2%)	12 (5.5%)	
	partial excavation of the carious lesion followed by definitive restoration in the same visit	5 (2.3%)	1 (0.5%)	9 (4.1%)	

The table no. 5 shows the results of the Chi-square test to examine the significance of the relationship between the variable of years of experience and their opinions on the question (When pulp proximity is present in cases of deep decay lesion what would be your option to manage this lesion), and it was found that there is no significant relationship, as the test showed a significance level of 0.157, which is a value higher than 0.05, indicating that the variable of years of experience is not considered an influencing factor in the actions taken by the doctor to address the problem.

Table no. 6: Shows the significant differences in years of experience.

Chi square test					
		Years of experience			
	Options	Less than 5 Years No. (%)	5 – 10 Years No. (%)	Over 10 Years No. (%)	P_ value
The initial setting time of Biodentine	9-12 minutes	28 (12.7%)	26 (11.8%)	21 (9.5%)	0.818
	One hours	6 (2.7%)	7 (3.2%)	8 (3.6%)	
	35-40 minutes	12 (5.5%)	18 (8.2%)	12 (5.5%)	
	Do not know	31 (14.1%)	25 (11.4%)	26 (11.8%)	
The initial setting time of MTA	9-12 minutes	18 (8.2%)	11 (5.0%)	18 (8.2%)	0.062
	One hours	22 (10.0%)	28 (12.7%)	12 (5.5%)	
	35-40 minutes	7 (3.2%)	11 (5.0%)	15 (6.8%)	
	Do not know	30 (13.6%)	26 (11.8%)	22 (10.0%)	
Which material has superior performance as direct pulp capping agent	Calcium hydroxide	14 (6.4%)	12 (5.5%)	15 (6.8%)	0.583
	MTA	27 (12.3%)	24 (10.9%)	26 (11.8%)	
	Biodentine	36 (16.4%)	40 (18.2%)	26 (11.8%)	

The table shows the results of the Chi-square test to examine the significance of the relationship between the variable of years of experience and their opinions on the question (The initial setting time of Biodentine), and it was found that there is no significant relationship, as the test showed a significance level of 0.818, also, was found that there is no significant relationship, as the test showed a significance level of 0.062, Indicating that the variable of years of experience is not a significant factor in the doctors' responses about the equation (The initial setting time of MTA)

Finally, the chi-square test showed no statistically significant relationship between the variable of years of experience and dentists' preferences at a significance level of 0.583.

Table no.7: Shows the levels of knowledge about material biodentine, MTA material.

Levels of knowledge		
	No.	%
Low knowledge	105	47.7%
Moderate knowledge	91	41.4%
High knowledge	24	10.9%

Table (7) illustrates the participants' levels of knowledge regarding Biodentine and MTA materials. The data reveals that nearly half of the participants (47.7%) possess a low level of knowledge. These results indicate some gaps in knowledge among the group of doctors participating in the study, highlighting the need to enhance educational efforts and professional training.

IV. Discussion

The results of this study reveal significant variation in the knowledge and clinical approaches among dental practitioners in Benghazi regarding the use of bioactive materials such as Biodentine and MTA for direct pulp capping procedures. The most frequently chosen approach among participants (47.7%) was complete excavation of the carious lesion followed by a temporary restoration and then a definitive restoration at a subsequent visit. This reflects a conservative clinical philosophy aimed at preserving pulp vitality and minimizing the risk of pulpal exposure. These findings are partially consistent with those of Sudarsan et al. 18who reported that 65.2% of dental students favored partial caries removal followed by temporary restoration in cases of deep carious lesions—an approach also grounded in biological preservation. However, the relatively low percentage (6.8%) of clinicians in the present study who opted for partial excavation with immediate definitive restoration suggests limited adoption of minimally invasive strategies that emphasize immediate pulp preservation, possibly due to concerns over long-term outcomes or limited confidence in material performance.

The knowledge assessment revealed clear gaps in understanding the fundamental physical properties of pulp capping materials. Only 34.1% of participants correctly identified the initial setting time of Biodentine (9–12 minutes), while 37.3% admitted not knowing the answer. This trend aligns with the findings of Sudarsan et al. 17where only 21.26% of dental students accurately reported the setting time. Regarding MTA, 35.5% of participants in the current study reported uncertainty about its setting time, indicating a general lack of familiarity with basic handling properties, even among practicing clinicians.

In terms of material preference for direct pulp capping, 46.4% of respondents selected Biodentine as the superior material, followed by MTA (35%) and calcium hydroxide (18.6%). These results reflect a growing inclination toward modern bioactive materials, supported by the clinical success rates reported by Drouri et al. 16where Biodentine achieved an 80% success rate after six months. Likewise, Lakhotia et al. 19 noted that 43% of pediatric dentists preferred Biodentine for direct pulp capping, with even higher preference among academic faculty members (58.3%). Nevertheless, a notable proportion of respondents in the current study continued to prefer calcium hydroxide, suggesting that traditional preferences persist, potentially influenced by habit, limited clinical exposure to newer alternatives, or a lack of continuing professional development—similar to the findings of Sudarsan et al. 18where 40.1% of participants still preferred calcium hydroxide despite the availability of more advanced options.

Participants' knowledge regarding the biological and mechanical properties of these materials was also variable. A majority (56.8%) agreed that Biodentine exhibits mechanical properties similar to dentin, closely echoing Sudarsan's findings (72.46%). However, when asked whether Biodentine induces the formation of a homogneous dentin bridge after pulp capping, only 41.4% agreed, while 38.6% were unsure. Similar uncertainty was observed regarding other critical properties. Only 37.3% recognized that Biodentine has lower porosity than MTA due to its lower water demand, and 39.5% were aware of its lower radiopacity. In comparison, Sudarsan et al. 18reported even lower awareness levels for these features (28.99% and 37.68%, respectively). Furthermore, 42.7% correctly identified that the antibacterial and antifungal effects of MTA and Biodentine are attributed to their high pH, whereas 43.6% did not know this key biochemical mechanism—highlighting a widespread lack of understanding of the biological mechanisms underpinning the efficacy of these materials.

Statistical analysis using the Chi-square test revealed no significant association between years of experience and clinical decision-making or knowledge. For instance, p-values for associations between experience and knowledge of setting time for Biodentine ($p = 0.818$), MTA ($p = 0.062$), and preferred material for pulp capping ($p = 0.583$) all exceeded the conventional threshold for significance. These results suggest that clinical experience alone does not equate to evidence-based material selection or updated knowledge. This diverges from the findings of Sudarsan et al. 18who reported that senior dental students exhibited a stronger preference for modern materials such as Biodentine, implying that structured academic exposure may play a more critical role in shaping clinical preferences than the accumulation of practical experience.

The overall level of knowledge among participants was concerning, with 47.7% classified as having low knowledge, 41.4% with moderate knowledge, and only 10.9% demonstrating high knowledge regarding Biodentine and MTA. These findings reinforce the conclusions of Fasoulas et al.20 whose systematic review and meta-analysis demonstrated that MTA and Biodentine outperform calcium hydroxide in clinical and radiographic success rates (85–90% vs. 70–75%), dentin bridge formation, and root development. Yet, knowledge of these advantages appears to be inconsistently internalized among practitioners, indicating a critical need for enhanced education, targeted workshops, and clinical training in biomaterial science.

When compared with the literature, the findings of this study underscore a growing shift toward modern bioactive materials in pulp therapy, yet they simultaneously reveal gaps in comprehension that could compromise optimal clinical decision-making. While the inclination to adopt materials like Biodentine is evident, inconsistent knowledge and persistent reliance on traditional practices suggest that formal interventions are necessary to bridge the gap between clinical innovation and practitioner readiness.

V. Conclusion

The findings of this study indicate a growing preference among dental practitioners in Benghazi for bioactive materials such as Biodentine and MTA in direct pulp capping procedures. However, this clinical inclination is not consistently supported by adequate knowledge regarding the fundamental properties, handling characteristics, and biological mechanisms of these materials. Despite nearly half of the participants favoring Biodentine over traditional agents like calcium hydroxide, significant gaps remain in understanding critical aspects such as setting times and antimicrobial actions. Furthermore, the lack of statistically significant correlation between years of experience and knowledge or clinical preferences suggests that practical experience alone does not guarantee up-to-date, evidence-based clinical decision-making. This highlights a critical need for enhanced education and training to bridge the gap between evolving dental materials science and everyday clinical practice.

References

[1]. Parirokh, M., & Torabinejad, M. Mineral Trioxide Aggregates: A Comprehensive Literature Review. Journal Of Endodontics.2010: 36(1), 16–27.

[2]. Morrison, E. C., Spencer, P., & Sahrmann, C. Management Of Deep Caries And The Vital Pulp In Restorative Dentistry. Journal Of The American Dental Association. 2011: 142(5), 561-568.

[3]. Nawras Maher Mostafa, Sandy Ahmed Moussa, "Mineral Trioxide Aggregate (MTA) Vs Calcium Hydroxide In Direct Pulp Capping, Literature Review" ARC Journal Of Dental Science. 2018:3(2):18-25.

[4]. Camilleri, J. Mineral Trioxide Aggregates: A Review Of The Chemical Properties And Clinical Applications. International Endodontic Journal.2014: 47(7), 707–730.

[5]. Sivakumar P, Naseem I. Biosmart Materials The Future Of Dentistry: A Review. Research Journal Of Pharmacy And Technology. 2016;9(10):1737-42.

[6]. Tziafas D, Smith AJ, Lesot H: Designing New Treatment Strategies In Vital Pulp Therapy. J Dent. 2000, 28:77- 92.

[7]. Abiraamasri BL, Gurunathan D. Comparison Of Ferric Sulphate And Calcium Hydroxide As A Pulpotomy Agent. Research Journal Of Pharmacy And Technology. 2018;11(5):1881-3.

[8]. Paula A, Carrilho E, Laranjo M, Abrantes AM, Casalta-Lopes J, Botelho MF, Et Al. Direct Pulp Capping: Which Is The Most Effective Biomaterial? A Retrospective Clinical Study. Materials [Internet]. 2019 Oct 16;12(20).

[9]. Seltzer S, Bender IB, Ziontz M. The Dynamics Of Pulp Inflammation: Correlations Between Diagnostic Data And Actual Histologic Findings In The Pulp. Oral Surg Oral Med Oral Pathol. 1963 Aug; 16:969–77.

[10]. Cox CF, Sübay RK, Ostro E, Suzuki S, Suzuki SH: Tunnel Defects In Dentin Bridges: Their Formation Following Direct Pulp Capping. Oper Dent. 1996, 21:4-11.

[11]. Lakhotia Et Al. Survey On Primary And Young Permanent Tooth Pulp Therapy As Practiced By Pediatric Dentists In Karnataka. Dent J Adv Stud. 2022;10:32–37.

[12]. Fuks AB. Current Concepts In Vital Primary Pulp Therapy. Eur J Paediatr Dent 2002; 3(3):115–20.

[13]. Asgary S, Shahabi S, Jafarzadeh T, Amini S, Kheirieh S. The Properties Of A New Endodontic Material. J Endod 2008; 34(8):990–3.

[14]. Torabinejad M, Hong CU, Mcdonald F, Pitt Ford TR. Physical And Chemical Properties Of A New Root-End Lling Material. J Endod 1995; 21(7):349–53.

[15]. Laurent, P., Camps, J., & About, I. Biodentine™ Induces TGF-B1 Release From Human Pulp Cells. International Endodontic Journal. 2012: 45(5), 439–448.

[16]. Drouri, S., El Merini, H., Sy, A., & Jabri, M. Evaluation Of Direct And Indirect Pulp Capping With Biodentine In Vital Permanent Teeth With Deep Caries Lesions. Cureus.2023: 15(5), E39374.

[17]. Koubi, G., Colon, P., & Franquin, J. C. Clinical Evaluation Of Biodentine. Clinical Oral Investigations.2013: 17(1), 243–249.

[18]. Sudarsan, R., Ganesh, S. B., & Anjaneyulu, K. Knowledge, Attitude, And Practice Of Usage Of MTA And Biodentine As Direct Pulp Capping Agents: A Questionnaire Study. International Journal Of Research In Pharmaceutical Sciences.2020: 11(SPL3), 3014.

[19]. Lakhotia, R., Urs, P., Jenny, A., Raghunath, V. N., Nagar, P., & Ninawe, N. Survey On Primary And Young Permanent Tooth Pulp Therapy As Practiced By Pediatric Dentists In Karnataka. Dental Journal Of Advanced Studies.2022: 10, 32–37

[20]. Fasoulas, A., Keratiotis, G., Spineli, L., Pandis, N., De Bruyne, M. A. A., De Moor, R. J. G., & Meire, M. A. Comparative Efficacy Of Materials Used Patients Undergoing Pulpotomy Or Direct Pulp Capping In Carious Teeth: A Systematic Review And Meta-Analysis. Clinical And Experimental Dental Research.2023: 9, 1129–1148.