

# PREFERENCES OF TREATMENTS AND MATERIALS USED IN THE MANAGEMENT OF EXPOSED PULPS: A WEB-BASED QUESTIONNAIRE STUDY

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## ABSTRACT

**INTRODUCTION:** There is no consensus regarding the options of treatments and materials used in the management of exposed pulps among dentists.

**OBJECTIVES:** The aim of this study was to investigate dentists' options of treatments (TO) and materials (MO) used to manage exposed pulps that occur during deep caries removal in asymptomatic permanent teeth, and how background characteristics of dentists influence these options.

**MATERIAL AND METHODS:** A web-based questionnaire was constructed and distributed randomly. The questionnaire investigated background characteristics, TO (direct pulp capping [DPC], root canal treatment [RCT], and partial and full pulpotomies) and MO (calcium hydroxide, TheraCal, MTA, and Biodentine).

**RESULTS:** There were 363 dentists who participated in the study. In asymptomatic exposed pulps, 43.0%, 45.5%, 2.5%, and 2.5% of respondents performed DPC, RCT, partial pulpotomy, and full pulpotomy, respectively. Performing vital pulp therapies (VPT) was significantly associated with endodontists (OR: 2.85, 95% CI: 1.30-6.20%,  $p < 0.01$ ), academic members (vs. non-academicians) (OR: 2.86, 95% CI: 1.36-6.03%,  $p < 0.01$ ), and respondents with a PhD degree (vs. bachelor's degree) (OR: 4.87, 95% CI: 1.39-17.02%,  $p < 0.05$ ), respectively. The preferred material for pulp capping was TheraCal (39.7%), followed by calcium hydroxide (33.9%), MTA (21.55%), and Biodentine (5.0%). Using calcium silicate-based materials was significantly associated with male dentists (OR: 4.09, 95% CI: 2.25-7.43%,  $p < 0.001$ ) or respondents with MSc degrees (OR: 3.63, 95% CI: 1.68-7.84%,  $p < 0.01$ ).

**CONCLUSIONS:** Vital pulp therapy and the use of MTA or Biodentine to manage exposed pulps are not performed routinely by general dental practitioners, non-academician, females, and dentists with bachelor's degrees in dental surgery.

**KEY WORDS:** root canal treatment, MTA, direct pulp capping, GDPs, exposed pulps.

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## INTRODUCTION

The treatment of deep dentin caries is a daily practice for most dentists worldwide. However, there is no consensus in the dental profession regarding the best practice protocol or materials in the event of pulp exposure during

management of deep carious lesions (DCL). Pulp exposure may occur during excavation of deep carious tissue. There are several options to manage this event, such as pulpectomy, followed by root canal treatment (RCT), which is considered the possible treatment of choice for permanent teeth with a success rate of 86-93% [1].

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However, with the revolutionary imaging facilities available by cone beam computed tomography (CBCT), evaluation studies reporting outcomes of RCT detected higher numbers of periapical lesions compared with that detected by periapical radiographs [2]. Similarly, in the management of DCL, pre-operative CBCT significantly identified a higher number of periapical radiolucency in teeth with symptoms of reversible pulpitis compared with periapical radiographs [3], indicating a high prevalence of periapical lesions. In addition, RCT weakens tooth structure and consumes efforts, equipment, time, and money [4]. All these can be maintained by providing the vitality of the pulp, which ensures keeping a protective damping effect, proprioceptive function, and tooth sensitivity that is definitely lost after RCT [5].

Vital pulp therapies (VPT) aim to maintain pulp vitality, including direct pulp capping (DPC), partial pulpotomy (PP), and full pulpotomy (FP). Outcomes of VPT reported by studies showed various figures, DPC (placement of a medicament directly over a small exposure) with calcium hydroxide had a 35% success rate after one year and low pulp survival after 5-10 years [6, 7] compared with another study showing high success rate of using MTA as a DPC agent [8]. PP and FP, which involve either partial or full removal of inflamed coronal pulp tissue beneath the exposure before placement of medicament, maintained a high success rate of up to 99.4% and 99.3% after 3 years [9].

## OBJECTIVES

There is no existing data regarding how dental professionals in Iraq manage exposed pulps. Therefore, the aim of this study was to investigate treatments and materials used to manage exposed pulps, and how the respondents' background characteristics (sex, years of experience, qualification, specialty, place of work, employment time, country of qualification, and working in academia) influence these choices. The null hypothesis stated that there is no difference in the preference of first VPT vs. RCT, secondly calcium silicate cements vs. calcium hydroxide in the management of exposed pulps after deep carious tissue excavation in asymptomatic teeth.

## MATERIAL AND METHODS

A web-based questionnaire was designed and piloted through staff members at the College of Dentistry. This was subsequently amended, reviewed, and approved by the Research Ethics Committee (Ref No.: 193520). The total number of registered Iraqi dentists, as officially provided by the Iraqi dental association, was around 6,000 dentists. A sample size calculation was carried out through the population for a descriptive sampling technique, with an expected response rate between 60 and 80, with 80% of power calculation. Therefore, 350 den-

tists were needed to respond. The online questionnaire was constructed using Google form, and the questionnaire was composed of five sections, including:

1) A section constructed as a cover letter explaining the purpose of the questionnaire and emphasis on anonymity.

2) To investigate demographic, background data of participants, including sex, years of work experience (< 5 years, 5-10 years, 10-20 years, and > 20 years of experience), dental qualification (Bachelor of Dental Surgery [BDS], Master of Science [MSc], and Doctor of Philosophie [PhD]), specialty (endodontist, general dental practitioner [GDP], and other specialties), place of work (private or public sector), employment time (part-time or full-time), working in academia (yes or no), and country of qualification (Iraq or abroad).

3) To investigate the choice of treatment for exposed pulps during excavation of deep carious tissue in asymptomatic teeth (RCT, DPC, PP, and FP, and treatment depending on the size of pulp exposure).

4) To investigate the material of choice for exposed pulps (calcium hydroxide – Ca(OH)<sub>2</sub>, MTA, TheraCal, and Biodentine).

5) To examine reasons for not using MTA or Biodentine for VPT, which included none, difficult to handle, cost, lack of apparent advantage, deficiency in training, never come across, or time-consuming.

The questionnaire was sent electronically via social media (Facebook), with respondents completing the form anonymously. Distribution was performed through sponsored ads and mailing to members of certain Iraqi dental Facebook groups, which were assigned using a simple randomization – lottery method to minimize bias in selection. The issue with respondents making more than one entry was excluded by using an IP-protection protocol. Respondents were asked to choose one suitable answer for each question. The questionnaire was available from April, 13<sup>th</sup>, 2020 to July, 13<sup>th</sup>, 2020. Responses in Google form were gathered and linked to an Excel sheet. The collected data were analyzed using statistical package SPSS v. 26 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were given as frequencies (*n*) and percentage (%).  $\chi^2$  test and *z* test were applied to investigate the influence of background characteristics on the preferences of the treatment/material options in management of exposed pulps. If Pearson  $\chi^2$  value was significant, the background characteristic variable was chosen as an independent variable for binary multivariate logistic regression analysis. Through this, odds ratios (OR) and their confidence intervals (CI) were calculated.

## RESULTS

The sample size of this study was 363 dentists. Table 1 shows the background characteristics of the respondents

in the study. It was found that 156 (43.0%), 165 (45.5%), 9 (2.5%), and 9 (2.5%) of the respondents performed DPC, RCT, PP, and FP, respectively, while 24 (6.6%) of them decided their choice of treatment depending on the size of pulp exposure, as shown in Table 2. There was no significant difference between the frequency of respondents who prefer RCT and those who prefer VPT ( $p = 0.49$ ). The country of qualification and the place of work was statistically significantly associated with the preference of the treatment options ( $p > 0.05$ ).

Gender was statistically significantly related to the preference of treatment options ( $p = 0.04$ ), and no statistically significant difference was found between females and males ( $p > 0.05$ ). Only FP was preferred by males (4.3%) significantly more than by females (0%) ( $p = 0.0096$ ). Years of experience of the respondents were statistically significantly associated with the preference of treatment options ( $p < 0.001$ ). RCT was preferred by respondents with < 5 years of experience ( $n = 66$ , 53.7%) more frequently than those with more than 20 years of experience ( $n = 24$ , 36.4%) ( $p = 0.023$ ). Also, FP was preferred by respondents with more than 20 years of experience more frequently than those with < 5 years (0%), 5-10 years (0%), and 10-20 years (0%) of work experience ( $p < 0.05$ ), respectively.

Qualifications of the respondents were statistically significant in the preference of treatment options ( $p = 0.002$ ). Direct pulp capping was preferred by 30 (58.8%) of respondents with PhD degree more frequently compared with 84 (40.0%) and 42 (41.2%) of respondents with BDS and MSc degrees, with  $p = 0.015$  and ( $p = 0.039$ ), respectively. RCT was preferred by 111 (52.9%) and 42 (41.2%) of the respondents with BDS and MSc degrees more frequently compared with 12 (23.5%) of respondents with PhD degree ( $p = 0.00016$  and  $p = 0.0315$ , respectively). No difference was found in other treatment options between different qualification degrees ( $p > 0.05$ ). The specialty of the respondents was statistically significantly associated with the preference of treatment options ( $p < 0.001$ ). Direct pulp capping was preferred by 54 (56.3%) of respondents with other specialties more frequently, compared with 72 (40.0%,  $p = 0.00318$ ) and 30 (34.5%,  $p = 0.00988$ ) of GDPs and endodontists. On the other hand, RCT was preferred by 102 (56.7%) of GDPs more frequently, compared with 33 (34.4%) and 30 (34.5%) of other specialties and endodontists ( $p < 0.05$ ), respectively. The option of 'depending on the size of pulp exposure' was preferred by 21 (24.1%) of endodontists compared to 0% and 3.1% of GDPs and other specialties ( $p < 0.05$ ), respectively. No difference was found in the preference of partial and full pulpotomies between different categories of specialty ( $p > 0.05$ ). The employment time of the respondents was statistically significantly associated with the preference of treatment options ( $p = 0.026$ ). DPC was preferred by 74 (51.1%) of respondents with part-time employment compared with 87 (37.8%) of respon-

**TABLE 1.** Background characteristics of respondents in the study

Categories	n (%)
Sex	
Females	153 (42.1)
Males	210 (57.9)
Years of experience	
< 5 years	123 (33.9)
5-10 years	81 (22.3)
10-20 years	93 (25.6)
> 20 years	66 (18.2)
Employment time	
Full-time	222 (61.2)
Part-time	141 (38.3)
Working in academia	
Yes	111 (30.6)
No	252 (69.4)
Qualification	
BDS	210 (57.9)
MSc	102 (28.1)
PhD	51 (14.0)
Specialty	
General practitioner	180 (49.6)
Other specialties	96 (26.4)
Endodontists	87 (24.0)
Place of work	
Private	140 (38.6)
Public	223 (61.4)
Country of qualification	
Iraq	318 (87.6)
Abroad	45 (12.4)

dents with full-time employment ( $p = 0.01314$ ). RCT was preferred by 54 (38.3%) of respondents with part-time employment compared to 111 (50.0%) of respondents with full-time employment ( $p = 0.029$ ). There was no significant difference in the preference of other categories of treatment options between respondents with part- and full-time employment ( $p > 0.05$ ). Working in academia was statistically significantly associated with the preference of treatment options ( $p < 0.001$ ). The frequency of respondents working in academia, who preferred direct pulp capping or RCT, did not differ from those who do not work in academia ( $p > 0.05$ ). PP and FP were preferred statistically significantly more frequently by respondents who work in academia compared with those who do not work in academia –  $p < 0.00001$  and  $p = 0.017$ , respectively.

**TABLE 2.** Frequencies and percentage of responses for treatment/ material options used in the management of exposed pulps in asymptomatic teeth

Treatment options	n (%)	Material type	n (%)
Direct pulp capping	156 (43.0)	Ca(OH) <sub>2</sub>	123 (33.9)
Root canal treatment	165 (45.5)	TheraCal	144 (39.7)
Partial pulpotomy	9 (2.5)	MTA	78 (21.5)
Full pulpotomy	9 (2.5)	Biodentine	18 (5.0)
Depending on the size of pulp exposure	24 (6.6)	Total	363 (100.0)
Total	363 (100.0)		

**TABLE 3.** Binary multivariate logistic regression analysis. Associations of respondents' background characteristics and exposed pulps management preferences

Background variable	Prefer vital pulp therapies for asymptomatic teeth with pulp exposures after deep carious lesions excavation		Prefer calcium silicate-based materials in pulp protection in vital pulp therapies in asymptomatic teeth	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Male (vs. female)	1.734 (1.06-2.82)	0.027*	4.09 (2.25-7.43)	< 0.001*
5-10 years (vs. < 5 years) experience	1.342 (0.69-2.5)	0.370, N.S.	Not tested	
10-20 years (vs. < 5 years) experience	1.365 (0.60-2.87)	0.412, N.S.	Not tested	
> 20 years (vs. < 5 years) experience	1.331 (0.59-2.90)	0.489, N.S.	Not tested	
MSc (vs. BDS) degree	1.186 (0.46-3.00)	0.719, N.S.	3.63 (1.68-7.84)	0.001*
PhD (vs. BDS) degree	4.876 (1.39-17.00)	0.013*	1.49 (0.57-3.90)	0.411, N.S.
Other specialty (vs. GP)	2.117 (0.94-4.75)	0.069, N.S.	Not tested	
Endodontist (vs. GP)	2.854 (1.30-6.23)	0.009*	Not tested	
Working in academia (vs. not)	2.868 (1.36-6.03)	0.006*	Not tested	
Full-time (vs. part-time) employment	1.626 (1.02-2.58)	0.040*	Not tested	
Abroad (vs. inside Iraq) country of qualification	Not tested		Not tested	

\*Statistically significant difference ( $p < 0.05$ ). N.S. – statistically non-significant difference

For the purpose of multivariate binary logistic regression, treatment options for asymptomatic teeth with pulp exposures were categorized into VPT and RCT. Only variables that showed a significant association with the preference of treatment options were included in binary logistic regression. Logistic regression showed that the preference of RCT was statistically significantly associated with being a respondent with BDS (vs. PhD), MSc (vs. PhD) degrees, GDP (vs. endodontist), and full-time employment (vs. part-time employment), with (OR: 4.87, 95% CI: 1.39-17.02%,  $p = 0.013$ ), (OR: 4.11, 95% CI: 1.66-10.14%,  $p = 0.002$ ), (OR: 2.85, 95% CI: 1.3-6.23%,  $p = 0.009$ ), and (OR: 1.62, 95% CI: 1.02-2.58%,  $p = 0.04$ ), respectively. On the other hand, the preference of VPT was statistically significantly associated with being an endodontist (vs. GDP), working in academia (vs. not working in academia), and having a PhD (vs. BDS) degree, with (OR: 2.85, 95% CI: 1.3-6.2%,  $p = 0.009$ ), (OR: 2.86, 95% CI: 1.36-6.03%,  $p = 0.006$ ), and (OR:

4.87, 95% CI: 1.39-17.02%,  $p = 0.013$ ), respectively, as shown in Table 3.

Respondents' preferences regarding the materials used for pulp protection in the management of exposed pulps are presented in Table 2. Years of experience, specialty, place of work, working in academia, country of qualification, and employment time did not show statistically significant association with the preference of materials' type ( $p > 0.05$ ).

Gender was statistically significantly associated with the preference of materials typically used in VPT ( $p = 0.003$ ). Ca(OH)<sub>2</sub> was preferred significantly more by females ( $n = 66$ , 43.1%) compared with males ( $n = 57$ , 27.1%) ( $p = 0.0014$ ). TheraCal was preferred by males ( $n = 93$ , 44.3%) more frequently than females ( $n = 51$ , 33.3%) ( $p = 0.034$ ). Biodentine was preferred statistically significantly more by males ( $n = 15$ , 7.1%) than females ( $n = 3$ , 2.0%) ( $p = 0.024$ ). No difference was found between males and females in the preference of MTA

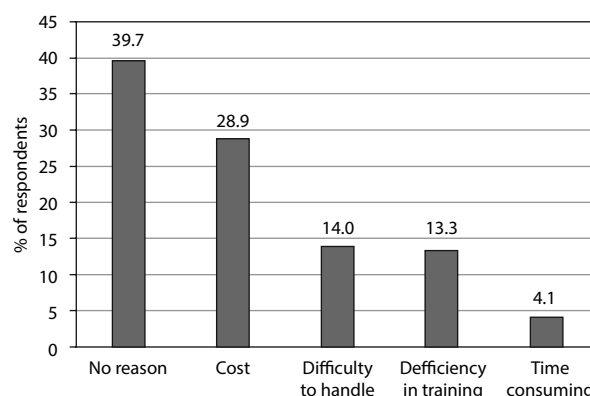
( $p > 0.05$ ). Qualification of the respondents showed statistically significant association with the preference of materials typically used for VPT ( $p = 0.008$ ).  $\text{Ca}(\text{OH})_2$  was preferred by respondents with PhD ( $n = 21$ , 41.2%) and BDS ( $n = 81$ , 38.6%) significantly more than respondents with MSc degree ( $n = 21$ , 20.6%) ( $p = 0.007$  and  $p = 0.001$ , respectively). No differences were observed in frequencies of respondents with BDS, MSc, and PhD degrees, who preferred TheraCal or MTA ( $p > 0.05$ ), while Biodentine was preferred significantly more by respondents with a MSc degree ( $n = 9$ , 8.8%) compared with respondents with a PhD degree 0% ( $p = 0.028$ ).

For the purpose of multivariable binary logistic regression, materials types were categorized into calcium silicate-based (including TheraCal, MTA, and Biodentine) and  $\text{Ca}(\text{OH})_2$ . Logistic regression showed that the preference of calcium silicate-based materials was statistically significantly associated with being a male (OR: 4.09, 95% CI: 2.25-7.43%,  $p < 0.001$ ) and a MSc degree (OR: 3.63, 95% CI: 1.68-7.84%,  $p = 0.001$ ), as shown in Table 3.

In a response to the question about reasons for not using MTA or Biodentine for exposed pulps, 39.7%, 28.9%, 14.0%, 13.3%, and 4.1% of respondents reported no reason, cost, difficulty to handle, deficiency in training, and time consuming, respectively, as shown in Figure 1.

## DISCUSSION

The present cross-sectional study found that the decision on the treatment option for pulp exposure in asymptomatic teeth was nearly comparable between DPC and RCT; therefore, the first null hypothesis was accepted. However, the frequency for choosing calcium silicate-based cement in comparison with  $\text{Ca}(\text{OH})_2$  was higher, thus the second hypothesis was rejected. Up to date, there are no studies investigating the attitude of Iraqi dental practitioners towards the techniques/materials used to manage exposed pulp occurring during carious tissue removal. This study provides the first evidence about the decision-making process in the management of exposed pulps by dental professionals in Iraq. The number of respondents in this study was representative of the dentist's population in Iraq (about 5,000 registered dentists in the Iraqi Dental Association). All management options were defined in the e-questionnaire to reduce the chances of misinterpretation. A limitation of this study is that only dentists who felt confident to answer have participated. Also, access to the e-questionnaire was restricted to professionals who do not use social media. Dental professionals were targeted using social media platforms because of the wide use, and rapid and effective sharing of information that could be achieved [10]. There are 1.52 and 2.7 billion active users of Facebook and other social media, respectively [11]. A survey study revealed that social media use



**FIGURE 1.** Reasons reported by respondents for not using MTA or Biodentine during vital pulp therapies (VPT) for exposed pulps

among medical professionals was reported to be an alternative way to exchange critical care topics, and Facebook was the most used social network site, with 87% participants having a profile [11].

The results of this study show no consensus about the preferred treatment options for exposed pulp in asymptomatic permanent teeth. 45% of the respondents preferred RCT compared with 43% of those who preferred DPC (Table 3). Lack of a consensus in literature may cause inconsistency in choosing treatment options, and such a variability may have an adverse effect on quality of dental care provided [12]. In asymptomatic restorable teeth with no history of spontaneous or lingering pain (reversible pulpitis), pulp exposure after deep carious tissue removal are preferably treated with DPC, if bleeding is controllable [13]. The rate of participants choosing DPC in this study (43%) appeared lower than that reported in other survey studies in Germany and France (68.0-92.7%), Finland (65%), and Spain (79%) [14-16]. However, it was similar to that reported in Northern Norway (51%) [17], using the same clinical scenario. This variation in reports can be attributed to the fact that it has been stated before that DPC as a treatment option is not sufficient in the management of exposed pulp in permanent teeth using  $\text{Ca}(\text{OH})_2$  [6, 7], and success rate of DPC might decrease with longer follow-up period. However, other studies reported a high success rate of DPC using MTA as pulp capping material [8, 18]. Based on the available evidence, it has been recommended recently that hydraulic calcium silicate material should be placed as pulp capping materials over the exposed pulps tissue in DPC, PP, and FP prior to temporary/definitive restoration [13].

In this study, although other specialties preferred DPC more frequently than GDPs and endodontists in the management of asymptomatic exposed pulps, 24.1% of endodontists based their treatment's decision on the size of pulp exposure. Also, PP and FP were statistically more frequently preferred by respondents who are



working in academia and endodontist. This is consistent with a recent clinical guidelines that encourage VPT for asymptomatic and reversibly inflamed teeth under aseptic, disinfected, and magnified operation field [13], where the skills of operator in determining the extent of pulp damage and controlling pulp bleeding are essential. These can be considered as the fundamental factors that may affect the success of PT procedure. Also, it can explain the results obtained in this study that being an endodontist or a respondent with a PhD degree, or a dentist working in academia would be associated with the preference of VPT more frequently than RCT in the management of exposed pulps in asymptomatic permanent teeth (Table 3). We believe that GDP and other specialties should always follow clinical guidelines for the management of DCL and exposed pulps recommended by a well-known endodontic society, such as the recently published ESE position statement [13].

Minimal invasive endodontics, such as PP and FP, are suggested recently to manage irretrievable and sever inflamed pulps [19], and to overcome problems associated with RCT, such as weakening of tooth structure and high tooth fracture susceptibility [20], persistent apical infection [21], and RCT, which are often subjected for re-treatment [22]. The success rate of PP and FP has been reported as 99.4% and 99.3% respectively, after 3 years [9]. Even for teeth diagnosed with irreversible pulpitis, FP maintains clinical and radiographic success of 78.1% of treated teeth after 5 years follow-up compared with 75.3% in RCT [23]. In addition, a recent systematic review concluded that FP is effective in managing DCL in teeth with signs and symptoms indicative of irreversible pulpitis, with clinical and radiographic success rated as 97.4% and 95.4%, respectively, after one-year follow-up [24]. This evidence encourages the introduction of minimally invasive endodontic methods as treatment protocols in the management of exposed pulps used by GDPs worldwide.

However, nearly half of the participants (45%) in the current study chose RCT as a treatment of choice for asymptomatic teeth with exposed pulps, and this was higher than in other studies performed in Germany and France (7-22%) [14], and Finland (26%) [15], but similar to that in Northern Norway (42%) [17]. In this study, 56.3% of GDPs preferred to perform RCT for asymptomatic teeth with exposed pulps, which indicates endodontic over-treatments of teeth with savable pulps. As minimally invasive endodontics were unpopular among GDPs in Iraq; similarly, we have found that less invasive excavation techniques of DCL were also unpopular. Even with the risk of pulp exposure, non-selective removal to hard dentine was the treatment of choice for asymptomatic teeth with DCL among GDPs [25]. Although  $\text{Ca}(\text{OH})_2$  is always considered as the gold standard for capping of exposed pulps, TheraCal was the most widely used material of choice for exposed pulps in this study (39.7%), followed by  $\text{Ca}(\text{OH})_2$  (33.9%), MTA (21%),

and Biodentine (5%) (Table 2). TheraCal is a resin-modified MTA-like material, proposed to be used as a pulp capping material; it contains about 45% of resin, 5% of thickening agent, 10% of radiopaque agent, and 45% of type III Portland cement as a mineral phase [26]. It was reported that TheraCal compared with Biodentine released a lower amount of calcium ions, and there was no calcium hydroxide formation during the hydration reaction, which was attributed to the presence of resin in the TheraCal's composition that may modify or hinder the hydration reaction of material [26]. The clinical and radiographic outcomes of primary teeth with exposed pulps capped with TheraCal versus MTA were comparable after 12 months [27]. However, a study found that TheraCal performed inferiorly to Biodentine and MTA in terms of clinical and histological outcomes, when used in a partial pulpotomy [28]. Histological evidence showed that there is a continuous dentin bridge formation in only 11% of teeth capped with TheraCal compared with 100% and 56% of teeth in the Biodentine and Pro Root MTA groups. Also, disorganized pulp tissue under the TheraCal material was evident in 66.6% of teeth in the TheraCal group compared to 22.2% and 33.3% in the MTA and Biodentine groups, respectively [28]. The presence of resin in TheraCal has a risk of providing a non-polymerized monomer, especially in a humid environment as in the vital pulp therapy, which may reach the pulp tissue and they are toxic to the pulp cells, causing a release of inflammatory mediators [29], which may explain a higher prevalence of incomplete dentin bridge formation under TheraCal. In addition to the toxic effect of non-polymerized monomer associated with TheraCal, incomplete dentin bridge formation over exposed pulp capped with TheraCal also risk micro-leakage of bacteria into the pulp, and may jeopardize the success of procedure. Therefore, there is insufficient evidence to support the use of TheraCal directly on the pulp.

$\text{Ca}(\text{OH})_2$  use in this study was lower than that reported in previous studies. In Spain, USA, France, Norway, and Germany,  $\text{Ca}(\text{OH})_2$  was chosen by 68%, 50%, 55%, 57%, and 52% of respondents, respectively, as a pulp capping material in DPC [14, 16, 30]. However, the use of  $\text{Ca}(\text{OH})_2$  (33.9%) in this study was similar to that reported in Finland (40%) [15]. There are many disadvantages associated with using  $\text{Ca}(\text{OH})_2$ , including solubility and weak mechanical properties [31], in addition to the emergence of new bioactive materials that may reduce its use in the management of exposed pulps.

MTA and Biodentine have been proposed recently as the material of choice for VPT instead of  $\text{Ca}(\text{OH})_2$  because of superior clinical and radiographical performance in exposed pulps compared with  $\text{Ca}(\text{OH})_2$  [32]. It has been found that there is no difference in clinical success rate between MTA and Biodentine when used as pulp capping materials in DPC and PP after 3 years follow-up [33]. Although cost-effectiveness analysis reported that DPC with  $\text{Ca}(\text{OH})_2$  was less cost-effective compared with DPC

and MTA [34], the cost was the second main reason stated by 28.9% of respondents for not using MTA or Biodentine as a pulp capping material for exposed pulps in this study. MTA was chosen by 21% of respondents, which is a higher rate than that reported its' use in another survey study in Spain (8%) [16]. In this study, calcium silicate-based materials use, including TheraCal, MTA, and Biodentine, were preferred by dentists with MSc versus BDS degrees (Table 3), indicating an association between the rate of using MTA-like materials and a higher academic/ educational level. In Finland, MTA was chosen by 39% of respondents and its' use was significantly associated with those who graduated after 1986 and those, who had attended continuing education courses in operative dentistry or endodontology by the Finnish Dental Society within the last 3 years [15].

## CONCLUSIONS

There is no consensus on the best management of asymptomatic exposed pulps after deep caries excavation. In the present study, TheraCal was the most preferred material for vital pulp therapies. Vital pulp therapies in the management of exposed pulps in asymptomatic permanent teeth are not common in clinical practice in Iraq, and there is an urgent need to educate GDPs on current scientific evidence.

## CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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