


## Factors Affecting the Decision-Making of Direct Pulp Capping Procedures Amongst Turkish Dental Practitioners

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### ABSTRACT

**Objective:** To examine the factors affecting the decision-making of direct pulp capping procedures amongst Turkish dental practitioners.

**Methods:** A total of 378 Turkish dentists participated in the survey. The questionnaire comprised three sections. The first part comprised questions regarding demographic features. The second part comprised questions on how treatment plans change according to factors such as pulp perforation position, number, size, how it occurred, and patient age. The third part composed of questions on the common materials and techniques used in pulp capping treatment. Descriptive statistics was calculated using Pearson's  $\chi^2$  test, and the risk assessments of factors affecting the choice of pulp capping decision were computed using logistic regression analysis.

**Results:** 85.18% of participants preferred the pulp capping treatment. When the perforation size was  $>1$  mm, males and university dentists decided more pulp capping treatments than females and private dentists respectively did ( $P < 0.05$ ). While the perforation size factor changed the dentists' decision most ( $OR = 6.85$ ), the patient's age factor least altered the choice ( $OR = 1.38$ ). Gender did not affect the decision of technique and material ( $P > 0.05$ ), but workplace and experience affected the choice of material ( $P < 0.05$ ). Technique did not affect the decision ( $P > 0.05$ ).

**Conclusion:** Turkish dentists prefer invasive treatments when risk factors in pulp capping treatment increase. The possible cause may be to reduce the rate of unsuccessful treatment; thus, ensure the continuity of patient confidence.

**Keywords:** Decision analysis, minimally invasive surgical procedures, pulp capping

### HIGHLIGHTS

- The increase in pulp perforation size leads Turkish dentists to prefer more invasive treatments compared to other pulp perforation cases.
- The age of the patient is the case that has the least effect on the direct pulp capping decision.
- The most preferred material and technique in direct pulp capping treatment is calcium hydroxide and definitive restoration-total caries removal, respectively.

### INTRODUCTION

The dental pulp performs a number of dynamic, biological mechanisms related to nutrition, innervation and defense responses. The loss of these functions would increase the liability to fractures (1). Direct pulp capping (DPC) is a treatment option that aims to promote pulp healing. It involves the placement of the medicament on the exposed pulp followed by coronal restoration as an attempt to maintain the vitality

of teeth (2). Consequently, the continuation of tooth vitality considerably increases the life time of the tooth in the oral cavity (3).

Several factors affect the success of the DPC. Whereas mechanically exposed pulp heals efficiently, exposure by carious decreases the ratio of successful treatment (4). In addition, DPC-applied young teeth survive longer than the older ones. Owing to the various distributions of blood vessels and odontoblasts in each region (5, 6), the location of exposure is an essential factor. Moreover, the number of bacteria entering the pulp increases as the size and number of the exposure rises; thus, the odds of success considerably decrease (7).

Many DPC materials have been recommended after the use of gold foil in DPC by Pfaff in 1756. Since 1928, and calcium hydroxide has become one of the most popular methods for DPC for stimulating the formation of tertiary dentine (8). In addition, mineral trioxide aggregate ProRoot

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MTA® (Dentsply Tulsa Dental, Johnson City, TN, USA) has been successfully utilized as an alternative DPC material for 20 years (9). Moreover, many new materials such as Biodentine® (Septodont, Saint-Maur-des-Fosses, France) and TheraCal (Bisco Inc, Schamburg, IL, USA) have been used by dentists for DPC (10, 11).

This study aimed to analyze the factors affecting the choice of Turkish dentists for DPC.

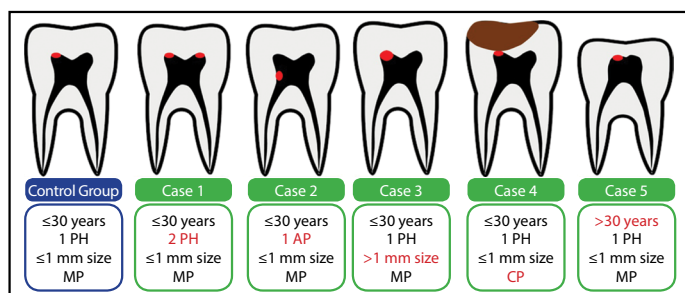
**MATERIALS AND METHODS**

Ethical approval was obtained from the ethical committee at Kahramanmaraş Sutcu Imam University in Turkey (2018-189). The sample size was calculated using Raosoft web survey software (<http://www.raosoft.com/samplesize.html>). With an 80% confidence interval, 5% alpha error, 26, 674 population size (according to TUIK statistical data in Turkey), 268 participants were required (12). The questionnaire survey was electronically conducted on 2316 dentists in Turkey in May 2018, but only 378 (16.32%) dentists responded. Distribution of Turkish dentists (n=378) according to gender (male, female), experience (≤10 years OR >10 years) and workplace (public OR university OR private) is demonstrated in Table 1.

The survey consisted of three sections. In the first section, the questions were focused on demographic details. In the second section, case presentation was made: \*The patient is under 30 years old, \*Perforation of pulp was occurred mechanically (MP), \*Perforation size is less than 1 mm, \*The number of perforation is one, \*Perforation location is near the pulp horn (PH), and \*No pain symptom, no lesion, no percussion sensitivity and radiographically normal periodontal space. Then, responses to the following questions were requested: What is your treatment plan for the patient with the above features (control group)? All other conditions in the patient are the

**TABLE 1.** Distribution of Turkish dentists (n=378) according to gender, experience, and workplace

Demographic features	Factors	n	%
Gender	Male	169	44.7
	Female	209	55.3
Experience	≤10 years	275	72.8
	>10 years	103	27.2
Workplace	Private	230	60.8
	Public	111	29.4
	Universities	37	9.8



**Figure 1.** Schematic presentation of control group and 5 different pulp perforation cases

same as the above ones, if the number of perforations was 2 (case 1), if the location of perforation was near the axial of pulp (PA) (case 2), if the size of perforation was larger than 1 mm (case 3), if the perforation was occurred by carious (CP) (case 4), if the patient’s age was over 30 years old (case 5), what would your treatment plan (DPC OR Other invasive treatments) (Fig. 1)? In the third section, the technique (Definitive [DR] OR Temporary [TR] restoration, Partial [PE] OR Total caries [TE] excavation) and dental material (calcium hydroxide OR MTA OR biodentine OR Others) dentists preferred most in the treatment of DPC was asked.

**Statistical analysis**

Data analysis was performed using the Statistical Package for the Social Sciences version 23.0 (SPSS Inc., Chicago, IL., USA). Descriptive statistics was calculated using Pearson’s  $\chi^2$  test for associations between the demographic characteristics of the dentists and their DPC decisions. In addition, the risk estimates of factors affecting the choice of DPC decision were computed using logistic regression analysis. The probability level for statistical significance was set at  $\alpha=0.05$ .

**RESULTS**

A total of 378 dentists participated in the study; 55.3% of the contributors were female. The ratio of those who have ≤10 years of experience in the study was 72.8%. While the ratio of private clinic dentists who partook in the study was the most (60.8%), the ratio of the dentists working at the universities was the least (9.8%) (Table 1).

In the control group, 85.18% of the participants preferred DPC (Fig. 2). In control group, while females tended to prefer DPC significantly more than males did (OR=0.89; P=0.009), in case 3, males tended to choose DPC significantly more than females did (OR=1.82; P=0.028). No significant difference was noted between the genders in the other cases (P>0.05) (Fig. 3). There was a significant difference only between the private and the university among working places for preferring DPC. In case 3, dentists of the universities preferred to perform DPC treatment significantly more than clinicians in private did (OR=0.42; P=0.007). No significant difference was noted between the workplaces in other cases (P>0.05) (Fig. 2). In the control group, those who had experience <10 years in dentistry preferred DPC significantly more than those who had >10 years’ experience (OR=0.89; P=0.028). In other cases, no significant difference was noted between the experiences (P>0.05) (Fig. 3).

**TABLE 2.** Associations between the demographic characteristics of the dentists and their DPC decisions

Pulp capping approaches	Demographic characteristics	$\chi^2$	P-value
Material	Gender	0.016	0.992
	Experience	9.37	0.009*
	Workplace	19.29	<0.001*
Technique	Gender	1.66	0.645
	Experience	1.29	0.73
	Workplace	6.84	0.335

\*Significant P<0.05

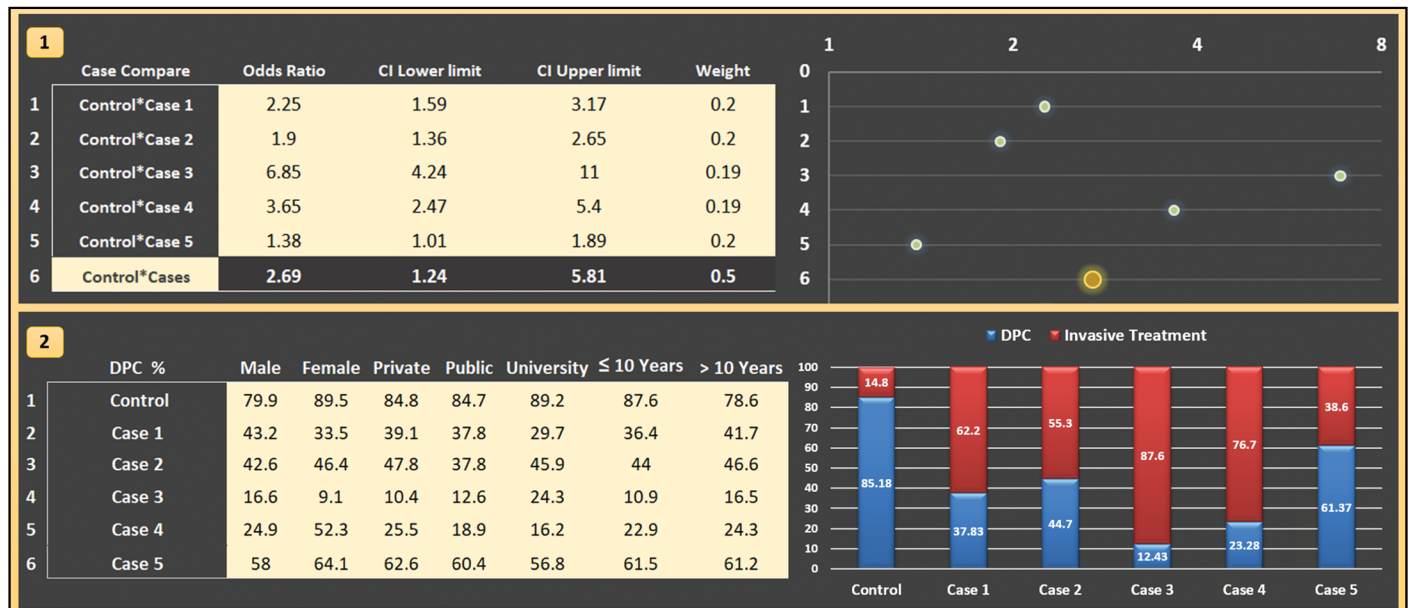


Figure 2. The risk estimates of factors affecting the choice of DPC decision using logistic regression analysis (1). Distribution (%) of the preferred treatment options according to demographic characteristics in each case (2)

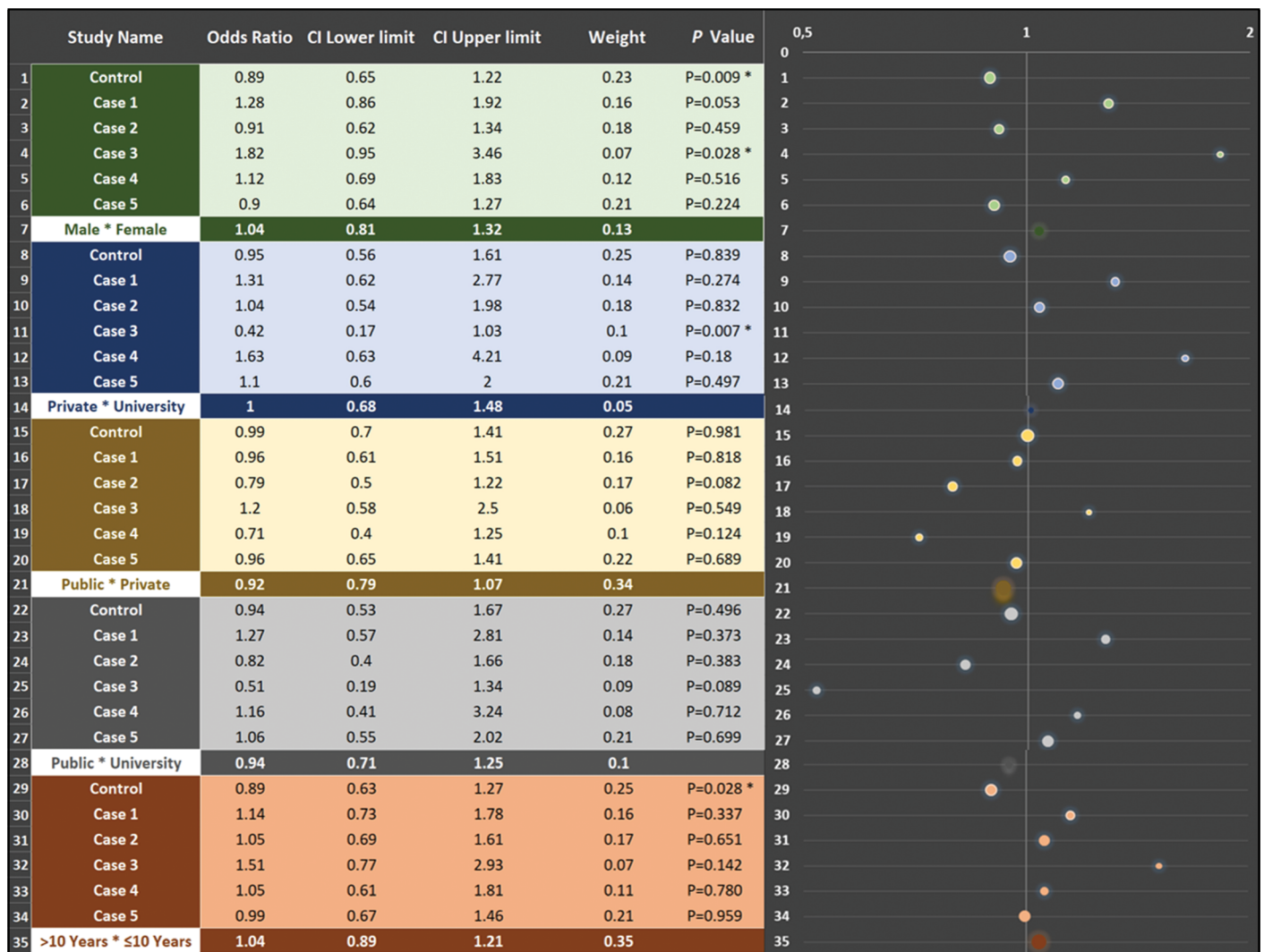


Figure 3. The risk estimates of factors affecting the choice of DPC decision according to demographic characteristics using logistic regression analysis and Pearson's  $\chi^2$  test (\*Significant P<0.05)



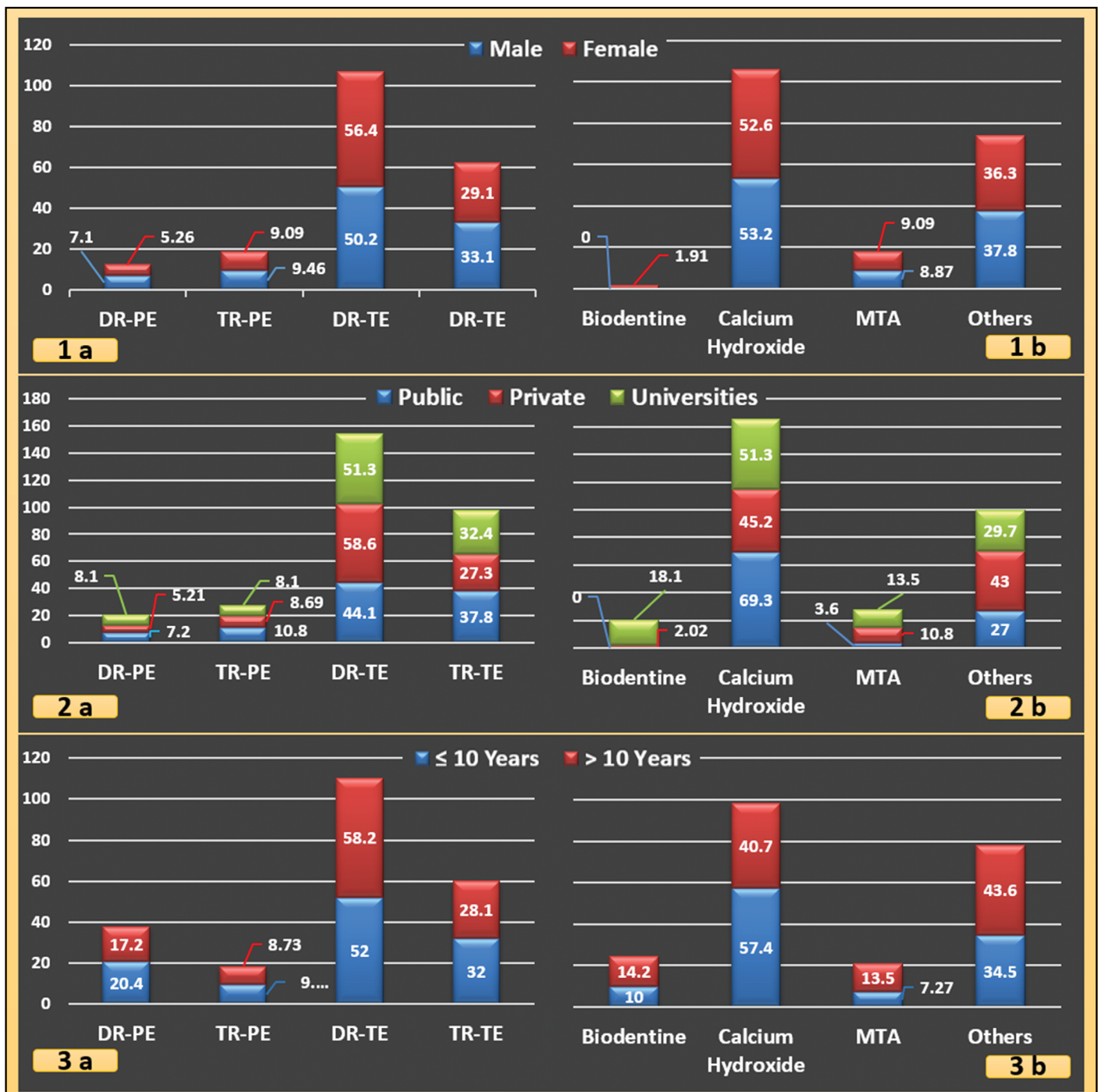


Figure 4. Effects of gender (1), workplace (2) and experience (3) on dental material (a) and pulp capping technique (b) selection

Compared with the control group, the decision of dentists to treat DPC changed most in case 3 (OR=6.85). However, case 5 was the least to affect the decisions of dentists (OR=1.38). The combined effect of the cases on the preference of the dentists compared with the control group was 2.69 times (Fig. 2).

Gender did not significantly affect the technique and material preferred for DPC ( $P>0.05$ ) (Table 2). Workplace factor significantly affected the material of choice for DPC ( $P<0.001$ ), but technique did not affect the decision ( $P=0.335$ ) (Table 2). Experience factor significantly affected the material of choice for DPC ( $P=0.009$ ), but technique did not affect the decision ( $P=0.73$ ) (Table 2). In gender, workplace, and experience fac-

tors, while calcium hydroxide was the most preferred dental material (M:53.2%, F:52.6%; university: 51.3%, private: 45.2%, public: 69.3%; ≤10 years: 57.4%, >10 years: 40.7%), DR-TE was the most preferred technique (M:50.2%, F:56.4%; university: 51.3%, private: 58.6%, public: 44.1%; ≤10 years: 52%, >10 years: 58.2%) (Fig. 4).

### DISCUSSION

The treatment of severely decaying teeth has always been challenging because of the possibility of damage to pulp tissue. While non-invasive treatments such as DPC may be preferred for treating damaged pulp, selecting more invasive treatments such as partial pulpotomy and root canal treatment

is also possible (13). However, DPC therapy is not always successful. Barthel, et al. (14) and Hørsted, et al. (5) reported 44.5% and 81.8% failure in the first five years after DPC therapy, respectively, and this rate increased over the years. The location, size, and number of perforation, the amount of saliva contamination, how perforation occurred, and patient's age may significantly affect the success of DPC treatment (1,4-7). In cases where success rates may be low, dentists may prefer more surgical approaches; also, the risk perception of each dentist is distinct, which leads to different treatment approaches (15, 16). In the control group of this study, DPC treatment was preferred at the rate of 85.18%, similar to a previously conducted study in Turkey (92.4%) (17).

This study shows that males prefer more radical treatments than females do. These results are coherent with the results of foregoing studies (15, 18-20). However, in the case that the perforation size increased, females tended to be more invasive than males did. Also, the same applies to private clinicians compared with university dentists. Dentists in private clinics may prefer to use invasive therapy for reducing the treatment failure as it negatively affects the confidence of patients. Another reason may be that more invasive treatments, such as root canal therapy, generate more income than treatments such as DPC do (18). In addition, similar to this study, it was confirmed in many studies that young dentists adopt more conservative treatments than older ones do (15, 16, 21-23). The possible causes of this positive situation may be because of current educators who encourage minimally invasive treatment options, and increasing the success of these conservative approaches by producing more biocompatible endodontic materials.

Whereas some investigators recommend DPC therapy only for perforations  $\leq 1$  mm in diameter, recent studies have shown that perforations  $> 1$  mm in diameter are equally successful (5, 24-27). In the present study, it was observed that the perforation size has the impact on the dental practitioners' decision to choose DPC approximately more than six times. In particular, the perforation size has been considered the most important risk factor in the failure of DPC by private dentists.

In this study, another condition that dentists consider approximately three times more risky in the treatment of DPC is pulp perforation caused by caries. In CP, the number of bacteria passing into the pulp is higher, whereas in MP, the inflammation remains superficial (28). While some studies indicate that the pulp perforation type does not change the outcome of DPC therapy (5, 29), other studies showed that MP provides better results than CP does (4, 5, 29, 30). In a study, DPC treatment was preferred by 51% US dentists in the case of CP. In this study, this ratio is 23.78% for Turkish dentists (31).

The number and region of perforations affect the DPC treatment decision about two times more than the control group. In previous studies (24, 26, 32), the number of pulp perforations does not significantly change the success of DPC treatment. Also, in some clinical studies, teeth whose pulp is perforated in the occlusal portion were found to be more successful than the proximal portion of the tooth in DPC treatment (32, 33). In contrast, most studies found that the region does not have a significant effect on the survival of the tooth (14, 24, 29, 34, 35). When

these studies are taken into consideration, it seems that Turkish dentists have a consistent approach in these cases.

The age of the patient was the least modulating factor in the dentists' decision-making. While a number of studies suggested that the age factor is effective in the success of DPC therapy (5, 6, 8, 32, 34), other studies indicated that it is ineffective (14, 24, 25, 27, 30, 36). It appears that there is no consensus on the impact of the age factor, and therefore, there is no clear evidence that DPC therapy should be only performed in young people (37). In this context, the attitude of Turkish dentists on the age factor seems consistent.

Calcium hydroxide has remained popular since its first use in 1928. It is still being used over 80% in France, Germany, and Norway (15). Also in this study, with 52.9%, calcium hydroxide was the most preferred DPC material by Turkish dentists. A number of clinical trials has been conducted on MTA that is alternative DPC material, and they were found to have a high success rate of 91% (34). MTA produces thicker dentine bridges and provides faster pulp healing than other DPC materials do; also, the risk of inflammation, hyperemia, and necrosis is lower (38). In many countries, despite this high success rate, MTA is less preferred by Turkish dentists because MTA has a long setting time, higher cost, and difficult handling properties compared to calcium hydroxide and others such as TheraCal LC (Bisco Inc, Schamburg, IL, USA) (15, 39). In addition, dentists working in the universities preferred biodentine more compared with the public and private practitioners. The therapeutic effects of biodentine such as dentin bridge formation and preservation of pulp function are similar to those of MTA. However, its setting time is as fast as 12 min, and that makes biodentine a strong alternative to the MTA (11).

PE was recommended for removing a part of caries leaving only discoloured dentine to avoid pulp perforation. TE method advocates removing all the soft and demineralized dentine to provide well-mineralized dentine under the restoration. While potential cariogenic activity is suppressed, the possibility of pulp perforation increases (40). Some studies stated that the success rate of TE method is lower than that of PE (41, 42), while other studies advocate TE technique (43-45). Similar to a study conducted in Turkey (46), it is observed in this study that the Turkish dentists' TE preference is considerably higher than for PE. Although these results are in agreement with the studies conducted in the USA and Brazil, Norwegian dentists seem to prefer the TE and PE methods at approximately the same rate (16, 31, 47). In this study, no difference was noted between the demographic groups at the point of the excavation technique. But, in a pilot study conducted by Vural et al. (17) in Ankara, Turkey, it was found that females and younger dentists preferred the TE method. The diversity of the study areas may have caused these different results.

There is no difference between DR and TR techniques among demographic groups in the study. However, in a Brazilian study, public dentists seem to prefer more DR in significant amounts (16). Bacteria remaining under restoration or leaking from the side of the fillings will reduce the success rate. In this respect, it was stated that the DR technique may be more successful than the TR (48).

## CONCLUSION

Turkish dentists prefer invasive treatments when risk factors in pulp capping treatment increase.

The possible cause may be to reduce the rate of unsuccessful treatment; thus, ensure the continuity of patient confidence. More studies are warranted to investigate factors affecting DPC decision making amongst practitioners in different countries.

### Disclosures

**Acknowledgements:** No potential acknowledgement relevant to this article was reported.

**Conflict of interest:** The authors report no conflicts of interest related to this study.

**Ethics Committee Approval:** Ethical approval was obtained from the ethical committee at Kahramanmaraş Sutcu Imam University in Turkey (2018-189).

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