Submitted: 09 October, 2024 Accepted: 12 December, 2024 Published: 03 September, 2025 DOI:10.22514/jocpd.2025.105

ORIGINAL RESEARCH

Journal of Clinical Pediatric Dentistry

Factors influencing restorative treatment decisions for proximal caries of primary and immature permanent teeth: a survey

Handan Vural[1,*], Sacide Duman[1]

[1]Department of Pediatric Dentistry, Faculty of Dentistry, Inonu University, 44280 Malatya, Türkiye

***Correspondence**
handan.vural@inonu.edu.tr
(Handan Vural)

Abstract

Background: The aim of this study was to determine restoration thresholds and restorative treatment decisions of dentists in Türkiye for proximal caries of primary and immature permanent teeth, to investigate factors associated with these decisions. **Methods**: The study was based on the evaluation of a prepared electronic survey. Participants completed a questionnaire comprising three sections: demographic information, daily clinical practices, hypothetical clinical case scenarios. The case scenarios section utilized diagram based on the Espelid classification (Degrees 1–6, ranging from outer enamel to inner dentine) to assess treatment thresholds and preferences. The first scenario *involved* a distal carious lesion on the upper second premolar of 14-year-old patient, while the second depicted a mesial carious lesion on the lower second primary molar of 5-year-old patient. The preference for Degrees 1–3 lesions were evaluated as early intervention. Statistical analysis was performed to examine the relationship between treatment thresholds, participant characteristics and clinical practices. **Results**: Total of 345 respondents participated, including general dentists (47.8%), pediatric dentists (26.7%), restorative specialists (8.1%), fifth-year college students (17.4%). In the first scenario, Degree 3 was the most frequently selected threshold (38.9%), with 59.1% favoring early intervention and 20.2% choosing Degrees 1 and 2. The box-only preparation method was preferred by 65% of respondents. In the second scenario, Degree 3 remained the most selected threshold, with 55.6% supporting early intervention and 17.1% opting for enamel-level thresholds. Total of 62.3% preferred the box-only preparation method. Pediatric dentists exhibited higher rates of early intervention compared to others. Composite materials were predominantly chosen for permanent teeth, while compomer materials were preferred for primary teeth. Gender, years of experience, and institution type significantly influenced the choice of restorative treatment and preparation method. **Conclusions**: Based on the questionnaire study, it was concluded that dentists in Türkiye have high tendency to intervene early.

Keywords

Dental caries; Dental materials; Deciduous tooth; Molar; Dental restoration

1. Introduction

The traditional "clean-prepare-fill" paradigm in the management of dental caries has been altered with recent developments in dental adhesives and restorative materials, as well as better understanding of the demineralization-remineralization process and the production of remineralization materials. Minimally invasive dentistry (MID) has become popular as an alternative for conventional treatments in current approaches [1].

"Clinical decision-making" represents a subjective process that integrates various elements, including the identification of caries, evaluation of lesion severity, monitoring progression, assessing caries activity and considering the individual's caries risk [2]. Individual factors of both the patient and the clinician lead to differences in when and how to intervene and with which restorative material to treat the decayed tooth [3–5]. There is a consensus that invasive restorations are indicated for permanent teeth with lesions extending beyond the outer third of dentin, reaching the middle or inner third, or exhibiting cavitation within the outer third. In contrast, non-active lesions, barring functional or aesthetic concerns, as well as non-cavitated carious lesions and those susceptible to cleaning, are generally managed through non-invasive or minimally invasive approaches [6]. In contemporary dentistry, initial carious lesions, specifically those classified as international caries detection and assessment system (ICDAS) 1–3 on occlusal surfaces and radiographically extending to the

outer and inner enamel halves, the enamel-dentin junction, and the outer third of dentin, are categorized as lesions that do not necessitate invasive restorative procedures [7–9]. The 2019 international caries classification and management system (ICCSM) guideline proposed a restoration threshold suggesting that invasive treatment is indicated for active lesions that cannot be halted or for moderate lesions (ICDAS 3 and 4) that are difficult to clean. The guideline further suggests that invasive treatment may be considered for moderate caries lesions in patients at high caries risk [7]. Invasive restorative procedures are often recommended for cavitated and enlarging lesions [10–13]. While evidence is limited for primary teeth, there is a consensus among some researchers that moderate lesions can be treated with non-invasive, minimally invasive, or conservative approaches [7, 9].

Espelid *et al.* [14, 15] developed a questionnaire to investigate dentists' restorative treatment decision thresholds, cavity preparations and restorative materials used in proximal and occlusal carious lesions of permanent teeth. The questionnaire was first used among Scandinavian dentists and later in many different countries, and these studies have shown wide variation in restorative treatment decisions [16–18]. Studies in the literature on this subject have mainly focused on the restoration thresholds of dentists in the management of caries of permanent teeth in adult patients [19]. However, there are very few studies in the literature on restoration thresholds in caries management of primary and immature permanent teeth [20–22].

The aim of this study is to evaluate the restorative treatment decisions made by Turkish dentists for interproximalcaries in primary and young permanent teeth using a validated questionnaire previously employed in other countries. Additionally, the study seeks to investigate the demographic factors associated with these decisions and to compare the findings not only at a national level but also with international data. The null hypothesis of the study is that various demographic factors of dentists do not affect restorative treatment decisions.

2. Materials and methods

2.1 Sample size calculation and participant criteria

Participants answered questionnaire on proximal caries lesions in primary and immature permanent teeth. The questionnaire was open for online participation between December 2021 and March 2022.

Participant criteria:

- General dentists (GDs) who perform restorative dental treatment in their daily work routine,
- Pediatric dentists (PDs) who have completed or are currently pursuing a minimum of 3 years of specialized training in the Department of Pediatric Dentistry,
- Restorative dentistry specialists (RDSs) who have completed or are currently pursuing a minimum of 3 years of specialized training in the Department of Restorative Dentistry,
- 5th year students continuing their education in dentistry faculties.

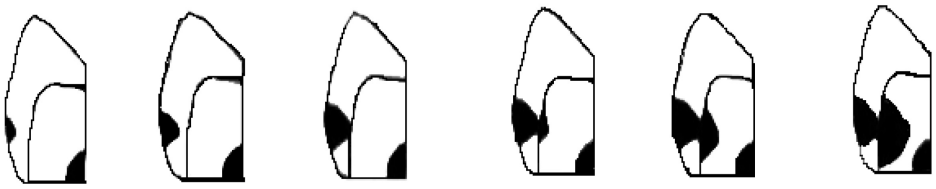
The answers of respondents who did not meet the criteria specified in the questionnaire responses were not considered. In addition, questionnaires that met the criteria but could not receive feedback on any of questions were also excluded from consideration. The minimum sample size required for the study was calculated as 272 with the G*Power program (version 3.1.4, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, NRW, Germany) when the effect size = 0.4, power = 0.95 confidence level $\alpha = 0.05$.

2.2 Questionnaire questions

To assess the participants' restorative treatment decisions and restorative threshold (RT) regarding proximal caries lesions in primary and immature permanent teeth, a questionnaire originally developed by Espelid *et al.* [14] for children and validated by Mullet-Bolla and Doméjean was used [20, 22]. The Turkish language validity of the survey questions was ensured through the back-translation method. The part of this questionnaire related to proximal caries management was adapted and used in this study. The case questions were prepared in Turkish by the researchers and finalized after obtaining expert opinions from 5 different pediatric dentists ensure their suitability for the purpose. The questionnaire comprised three main sections. The first section included demographic questions, prompting participants to provide information such as their gender, age and years of experience. The second section focused on their daily clinical practices, inquiring about the frequency of restorative treatments. The third section presented hypothetical clinical case scenarios, where participants were asked about their treatment thresholds and preferences for managing primary and immature permanent teeth in pediatric patients.

2.3 Clinical case questions

In the clinical hypothetical case scenarios, participants were presented with *involving* two children, both of whom demonstrated good oral hygiene, used fluoride toothpaste, visited the dentist annually, and were cooperative. The first scenario depicted a carious lesion located distally to the upper second premolar of a 14-year-old patient, while the second scenario *involved* a carious lesion mesially to the lower second primary molar of a 5-year-old patient. The scenarios were accompanied by a diagram showing interproximal carious lesions categorized by increasing depth according to the Espelid classification. These classifications also corresponded to caries lesions 1–6 in ICDAS radiographic scoring system [23]. This classification detailed six degrees of caries severity: Degree 1 (D1) represented a lesion margin on the outer half of the enamel; Degree 2 (D2) indicated a margin on the inner half of the enamel; Degree 3 (D3) reached the enamel-dentine junction (EDJ); Degree 4 (D4) *involved* the outer third of dentine; Degree 5 (D5) pertained to the middle third of dentine; and Degree 6 (D6) encompassed the inner third of dentine [6]. Fig. 1 (Ref. [2, 14]) shows the proximal caries diagram according to the Espelid and ICDAS classification. In Question 1, participants were asked to select the smallest degree on this diagram at which emergency restorative treatment should be applied. In Question 2, participants were asked which type of preparation they would prefer to use for their chosen caries



	D1	D2	D3	D4	D5	D6
Espelid [14]	outer half of the enamel	inner half of the enamel	enamel-dentine juction	outer 1/3 of the dentine	middle 1/3 of the dentine	inner 1/3 of the dentine
ICDAS [2]	ICDAS-RA 1	ICDAS-RA 2		ICDAS-RA 3	ICDAS-RB 4	ICDAS-RC 5

FIGURE 1. The proximal caries diagram according to the Espelid and ICDAS classification. ICDAS: international caries detection and assessment system.

lesion in each scenario (1: traditional class II, 2: box-only, 3: tunnel). Question 3 asked which restorative material they would choose for the proximal lesions (amalgam, composite, compomer, conventional glass ionomer cement (conv. GIC), resin-modified glass ionomer cement (RMGIC), high viscosity glass ionomer (HVGIC) sandwich technique: glass ionomer cement, compomer or composite). Since there is no definite threshold in dentistry regarding restoration decisions, it was planned to make an evaluation based on various consensus [6, 9, 11, 13, 24]. In the light of the existing literature, according to the answers given by the participants to the questions related to the threshold at which they indicated that they would perform restorative procedures, the preference for D1, D2 and D3 lesions were evaluated as early intervention.

After the questionnaire questions were prepared, they were converted into a web-based questionnaire through Google Forms®. The questionnaire started with an explanatory section for the participants and consent was obtained electronically for participation in the questionnaire. The web-based questionnaire was distributed through social media. Since the participants' e-mail addresses were not collected, they were not reminded of the questionnaire again and were asked to answer the questionnaire only once.

2.4 Statistical analysis

The data were evaluated using SPSS "Statistical Package for Social Sciences (SPSS 22.0)" program (IBM Corp, Armonk, NY, USA). Descriptive analyses were given using means and standard deviations for normally distributed variables. Frequency and percentage for categorical variables, arithmetic mean and standard deviation for variables with numerical values were used to summarize descriptive characteristics of participants. Descriptive analyses were completed using frequency distribution and cross-tabulations of variables. Pearson Chi-Square test was used for comparisons of qualitative variables. The level of statistical significance was $p < 0.05$.

3. Results

The total number of participants was 410. The responses of 65 participants were not evaluated because they did not meet the participation or response criteria. The number of responses accepted for evaluation was 345. Among these participants, 69.3% were female and 30.7% were male. In terms of professional backgrounds, 47.8% were general dentists, 26.7% were pediatric dentists, 8.1% were specialists in restorative dental treatment, and 17.4% were fifth-grade students. In our evaluation of the questionnaire, GDs had the highest average daily number of restorative procedures, while restorative dental treatment specialists (RDTSs) had the lowest (Table 1).

3.1 Scenario 1

In the first scenario, a carious lesion was identified distally to the upper second premolar in a 14-year-old patient. Table 2 presents the responses from various groups based on their areas of expertise regarding the question about RT. In this scenario, 59.1% of all participants stated that they would intervene in lesions early (GD: 60%, Pediatric dentists: 61.9%, RDTS: 32.2%, Student: 65%). Additionally, 20.2% of participants believed that intervention was necessary while the lesion was still within the enamel boundaries. No statistically significant difference was found among the participant groups regarding their RT choices in Scenario 1 ($p = 0.067$). The D3 threshold (38.9%) was the most frequently selected among all participants, regardless of their group affiliation (GD: 39.4%, PD: 39.1%, Students: 41.7%, RDTS: 28.6%). The D4 threshold was predominantly chosen by RDTSs, at a rate of 35.7%.

In Scenario 1, 80.3% of participants chose for minimally invasive cavity preparation for the proximal carious lesion of the permanent tooth, with 15.3% choosing tunnel preparation and 65% selecting box-only preparation. In contrast, 19.7% favored traditional Class II preparation. GDs (57%) and PDs (100%) showed a most preference for box-only preparation, while RDTSs (67.8%) leaned towards tunnel preparation, and students (50%) preferred traditional Class II preparation. Relevant data can be found in Table 2. Additionally, the study assessed the relationships between restoration threshold choices, preparation methods across all scenarios, and factors such as gender, institution, years of experience, and various treatment routines of the GDs, pediatric dentists, and RDTSs *involved* in the questionnaire (Table 3).

Male PDs (76.4%) were more likely than female (58.7%)

TABLE 1. Demographic characteristics of participants and information on participants' treatment routines.

	GD N (%)	PD N (%)	RDTS N (%)	Student N (%)	Total[b] N (%)
Gender[a]					
Female	112 (46.9)	75 (31.4)	22 (9.2)	30 (12.6)	239 (69.3)
Male	53 (50.0)	17 (16.0)	6 (5.7)	30 (28.3)	106 (30.7)
Type of practice[a]					
Public	79 (87.7)	12 (13.3)	1 (1.1)	-	92 (26.7)
Private	86 (77.5)	24 (21.6)	1 (0.9)	-	111 (32.2)
University	-	56 (68.3)	26 (31.7)	-	82 (23.8)
Student	-	-	-	60 (100.0)	60 (17.4)
Professional Experience (yr)[a]					
Student	-	-	-	60 (100.0)	60 (17.4)
0–2	57 (89.1)	7 (10.9)	-	-	64 (18.6)
3–5	47 (66.2)	22 (31.0)	2 (2.8)	-	71 (20.6)
6–10	24 (32.0)	35 (46.7)	16 (31.3)	-	75 (21.7)
≥11	37 (49.3)	28 (46.7)	10 (13.3)	-	75 (21.7)
Position[a]					
General Dentist	165 (100.0)	-	-	-	165 (47.8)
Academician	-	33 (60.0)	22 (40.0)	-	55 (15.9)
Specialist	-	31 (91.2)	3 (8.8)	-	34 (9.9)
Spec. Stu.	-	28 (90.3)	3 (9.7)	-	31 (9.0)
Student	-	-	-	60 (100.0)	60 (17.4)
Patient age range[a]					
0–6 yr	71 (37.1)	92 (48.1)	-	29 (15.8)	191 (53.4)
7–13 yr	103 (41.2)	91 (36.4)	2 (0.8)	54 (21.6)	250 (72.5)
14–17 yr	105 (52.5)	38 (19.0)	7 (3.5)	50 (25.0)	200 (58.0)
≥18 yr	157 (62.00)	12 (4.74)	28 (11.06)	56 (22.13)	253 (73.30)
Avg. Restoration (Number)[a]					
1–5	76 (45.2)	29 (17.3)	8 (17.3)	55 (32.7)	68 (48.7)
6–10	63 (48.1)	48 (36.6)	15 (11.5)	5 (3.8)	131 (38.0)
11–15	18 (60.0)	8 (26.7)	4 (13.3)	-	30 (8.7)
≥16	8 (50.0)	7 (43.8)	1 (3.6)	-	16 (4.6)
Primary tooth treatment[a]					
Yes	128 (44.8)	92 (32.2)	7 (2.4)	59 (20.6)	286 (82.9)
No	37 (62.7)	-	21 (35.6)	1 (1.7)	59 (17.1)
Treatment frequency[a]					
Often	35 (24.1)	92 (63.4)	-	18 (12.4)	145 (42.0)
Sometimes	114 (67.1)	-	15 (8.8)	41 (24.1)	170 (49.3)
None	16 (53.3)	-	13 (43.3)	1 (3.3)	30 (8.7)

GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists; Avg. Restoration: Average Number of Restorations Per Day; Spec. Stu.: Specialization Student; [a]: Horizontal percentage; [b]: Vertical percentage.

TABLE 2. Distribution of RT and preparation method choices by participant groups in Scenario 1.

	RT						*p*	Preparation type		
	D1 + D2 N (%)		D3 N (%)	D4 N (%)	D5 + D6 N (%)			Traditional Class II N (%)	Box N (%)	Tunnel N (%)
GD	D1 12 (7.3) D2 22 (13.3)	34 (20.6)	65 (39.4)	34 (20.6)	D5 12 (7.3) D6 20 (12.1)	32 (19.4)		38 (23.0)	94 (57.0)	33 (20.0)
PD	D1 6 (6.5) D2 15 (16.3)	21 (22.8)	36 (39.1)	23 (25.0)	D5 7 (7.6) D6 5 (5.4)	12 (13.0)	0.067	-	92 (100.0)	-
RDTS	D1 - D2 1 (3.6)	1 (3.6)	8 (28.6)	10 (35.7)	D5 6 (21.4) D6 3 (10.7)	9 (32.1)		-	9 (32.2)	19 (67.8)
Student	D1 6 (10.0) D2 8 (13.3)	14 (23.3)	25 (41.7)	13 (21.7)	D5 4 (6.7) D6 4 (6.7)	8 (13.3)		30 (50.0)	29 (48.3)	1 (1.7)
Total	D1 24 (6.9) D2 46 (13.3)	70 (20.2)	134 (38.9)	80 (23.2)	D5 29 (8.4) D6 32 (9.3)	61 (17.7)		68 (19.7)	224 (65.0)	53 (15.3)

GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists; RT: restorative threshold.

to choose early intervention for lesions (D1–3). 75% of pediatric dentists in public institutions reported that they would intervene in lesions (D4–6) that had reached the outer 1/3 of the dentine or more advanced. This rate was 40% in working private institutions and 33.9% in working universities. The rate of lesion intervention at enamel level increased with increasing professional years of pediatric dentists. Academician pediatric dentists favored early intervention, even before the lesion reached the middle 1/3 of dentine. (D1–4), while 30.4% reported that they would intervene when the lesion was at the enamel (D1–2). 22.6% of specialists and 14.3% of residents would intervene when the lesion was at the enamel level.

Fig. 2 shows that dentists in all groups chose composite as the most common material for Scenario 1 (GDs 71%, PDs 88%, RDTSs 96.4%, Student 65%). 76.5% of all participants stated that they would perform restoration with composite material. Amalgam was the least preferred material (1.2%) and all of dentists who preferred it were GDs (2.4%). Those who preferred conv. GIC were GDs (5.5%) and students (1.7%).

GDs employed in private institutions chosen for conventional Class II preparation at a significantly higher rate (37.2%) compared to their counterparts in public institutions (7.6%). Conversely, a significantly larger proportion of GDs in public institutions (31.6%) selected tunnel preparation compared to those in private settings (9.3%) ($p = 0.001$) (Table 4).

There was also a significant relationship between the years of professional experience of GDs and their preparation choices ($p = 0.008$). It was determined that as the average number of restorative procedures performed per day by GDs increased, the frequency of choosing conventional preparation decreased and there was a statistically significant difference ($p = 0.0001$). There was no statistically significant difference between the threshold choices of the PD participants and their demographic characteristics or treatment routines ($p > 0.05$) (Table 4).

The distribution of RT and preparation preferences of RDTS participating in the study was analyzed according to demographic characteristics and treatment routines. Relevant data are given in Tables 3 and 4. Accordingly, no significant difference was found between demographic characteristics, treatment routines, treatment thresholds and preparation preferences ($p > 0.05$).

3.2 Scenario 2

In the second scenario *involved* a carious lesion mesially to the lower second primary molar of a 5-year-old patient. The answers given by the groups according to their specialty to the question about RT are given in Table 5. In Scenario 2, 55.7% of GDs, 63% of PDs, 32.2% of RDTSs and 55% of students stated that they would intervene early in lesions (D1–3). This rate was 55.6% of all participants. 17.1% of all participants would intervene when the lesion was at the enamel level.

D3 (EDJ) was the most chosen threshold degree among all participants, regardless of group and in each group for GDs, PDs and students (38.5%, 41.2%, 39.1%, 35%, respectively). RTDSs, on the other hand, chose lesions extending to outer 1/3 of the dentine at the highest rate of 39.3% (D4) as the threshold. There was no significant difference in threshold selection between the groups ($p = 0.551$).

TABLE 3. RT choices according to demographic characteristics and treatment routines of the groups in Scenario 1.

	GD					PD					RDTS				
	D1 + D2 N (%)	D3 N (%)	D4 N (%)	D5 + D6 N (%)	*p*	D1 + D2 N (%)	D3 N (%)	D4 N (%)	D5 + D6 N (%)	*p*	D1 + D2 N (%)	D3 N (%)	D4 N (%)	D5 + D6 N (%)	*p*
Gender															
Female	20 (17.9)	42 (37.5)	28 (25.0)	22 (19.6)	0.181	18 (24.0)	26 (34.7)	21 (28.0)	10 (13.3)	0.318	1 (4.5)	6 (27.3)	6 (27.3)	9 (40.9)	-
Male	14 (26.4)	23 (43.4)	6 (11.3)	10 (18.9)		3 (17.6)	10 (58.8)	2 (11.8)	2 (11.8)		-	2 (33.3)	4 (66.7)	-	
Type of practice															
Public	16 (20.3)	35 (44.3)	15 (19.0)	13 (16.5)		1 (8.3)	2 (16.7)	4 (33.3)	5 (41.7)		-	-	1 (100.0)	-	
Private	18 (20.9)	30 (34.9)	19 (22.1)	19 (22.1)	0.614	7 (29.2)	10 (41.7)	5 (20.8)	2 (8.3)	0.103	-	-	-	1 (100.0)	-
University	-	-	-			13 (23.2)	24 (42.9)	14 (25.0)	5 (8.9)		1 (3.8)	8 (30.8)	9 (34.6)	8 (30.8)	
Professional Experience (yr)															
0–2	5 (8.8)	-	5 (8.8)	-		5 (17.2)	13 (44.8)	6 (20.7)	5 (17.2)		-	-	-	-	
3–5	14 (29.8)	17 (36.2)	12 (25.5)	4 (8.5)	0.018*					0.440	-	-	1 (50.0)	1 (50.0)	-
6–10	3 (12.5)	11 (45.8)	4 (16.7)	6 (25.0)		7 (20.0)	14 (40.0)	8 (22.9)	6 (17.1)		-	4 (25.0)	6 (37.5)	6 (37.5)	
≥11	12 (32.4)	14 (37.8)	2 (5.4)	9 (24.3)		9 (32.1)	9 (32.1)	9 (32.1)	1 (3.6)		1 (10.0)	4 (40.0)	3 (30.0)	2 (20.0)	
Avg. Restoration (number)															
1–5	17 (22.4)	27 (35.5)	16 (21.1)	16 (21.1)		6 (20.7)	15 (51.7)	5 (17.2)	3 (10.3)		1 (12.5)	2 (25.0)	3 (37.5)	2 (25.0)	
6–10	12 (19.0)	26 (41.3)	16 (25.4)	9 (14.3)	0.349	11 (22.9)	14 (29.2)	17 (35.4)	6 (12.5)	0.201	-	3 (20.0)	6 (40.0)	6 (40.0)	-
11–15	5 (27.8)	8 (44.4)	2 (11.1)	3 (16.7)		4 (26.7)	7 (46.7)	1 (6.7)	3 (20.0)		-	3 (60.0)	1 (20.0)	1 (20.0)	
≥16	-	4 (50.0)	-	4 (50.0)		6 (20.7)	15 (51.7)	5 (17.2)	3 (10.3)		1 (12.5)	2 (25.0)	3 (37.5)	2 (25.0)	
Treatment Frequency															
Often	7 (20.0)	10 (28.6)	8 (22.9)	10 (28.6)		-	-	-	-		-	-	-	-	
Sometimes	23 (20.2)	48 (42.1)	21 (18.4)	22 (19.3)	0.212	-	-	-	-	-	1 (6.7)	8 (53.3)	3 (20.0)	3 (20.0)	-
None	4 (25.0)	7 (43.8)	5 (31.3)	-		-	-	-	-		-	-	7 (53.8)	6 (46.2)	
Position															
Specialist	-	-	-	-		7 (22.6)	10 (32.3)	8 (25.8)	6 (19.4)		-	-	-	-	
Academician	-	-	-	-		10 (30.3)	15 (45.5)	8 (24.2)	0		-	-	-	-	-
Spec. Stu	-	-	-	-		4 (14.3)	11 (39.3)	7 (25.9)	6 (21.4)		-	-	-	-	

GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists; Avg. Restoration: Average Number of Restorations Per Day; Spec. Stu.: Specialization Student.

**: p value < 0.05 considered significant.*

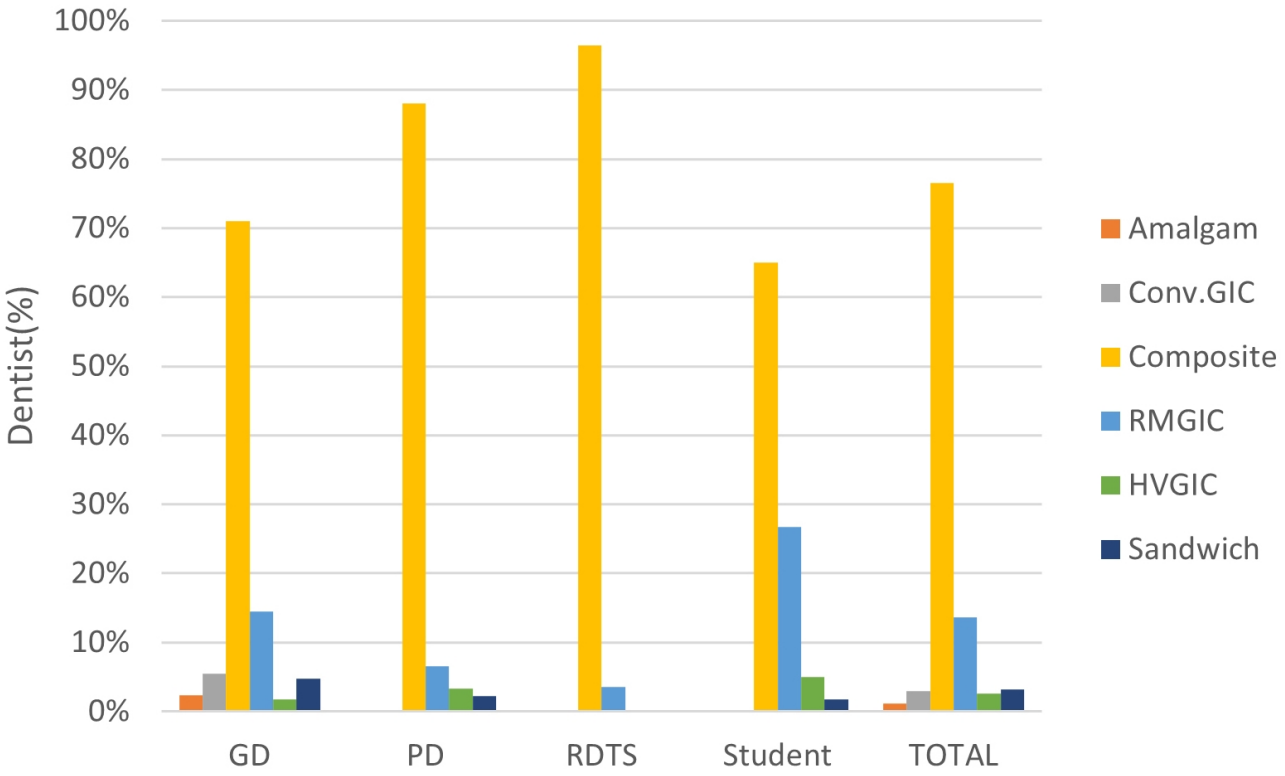


FIGURE 2. Distribution of material choices according to participant groups in scenario 1. GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists; Conv.GIC: conventional glass ionomer cement; RMGIC: resin-modified glass ionomer cement; HVGIC: high viscosity glass ionomer.

Seventy-one percent of participants preferred to use minimally invasive cavity preparation for primary tooth proximal caries lesion tunnel (8.7%) and box-only cavity preparation (62.3%); 29% chose class II preparation. GDs (38.2%) were the group most likely to prefer traditional class II preparation and RDTSs (85.7%) the most likely to prefer MID.

Fig. 3 shows that dentists in all groups selected compomers as the most common material for Scenario 2. PDs were the most preferred group for compomers (69%). The second material for all participants was composite (26.1%). The 2nd most preferred material by RDTSs was HVGIC (21.40%).

A statistically significant difference in choices based on gender was observed among the participating GDs ($p = 0.048$) (Table 6). Male GDs preferred lesions at the enamel level (D1–2) as RT 14.7% more than women. There was no statistically significant difference in the choice of RT, other demographic characteristics and treatment routines ($p > 0.05$) (Tables 6 and 7).

There was a statistically significant difference in the choice of preparation of GDs between professional years and frequency of treatment. GDs with 11 or more years of experience were 37.6% more likely to choose conventional preparation than those with 0–2 years of professional experience. As the number of years of experience increased, box-only preparation was more preferred ($p = 0.0001$). In addition, GDs with a higher frequency of primary dental treatment tended to prefer conventional preparation, while those with a lower frequency preferred conservative preparation methods.

In Scenario 2, there was a statistically significant difference ($p < 0.05$) in the choice of RT among PDs, influenced by gender and their place of employment. Male PDs (82.4%) were more likely than females (58.7%) to choice for early intervention for lesions (D1–3) ($p = 0.001$). Additionally, those working in public institutions preferred D5 and D6 for restorative treatment by 29.2% more than their counterparts in private institutions, and by 34.6% more compared to those in universities ($p = 0.03$). Among PDs, those in private institutions preferred traditional preparations 29.5% more than those in universities ($p = 0.02$). Traditional preparation was chosen by 6.9% of PDs with 0–5 years of experience and by 30.2% of those with 6 years or more. As professional years increased, the choice of traditional preparation also increased ($p = 0.033$). There was no significant difference in the choice of threshold and preparation, demographic characteristics and treatment routines of RDTSs in Scenario 2 ($p > 0.05$) (Tables 6 and 7).

4. Discussion

The literature suggests avoiding invasive treatment of lesions until they reach the outer 1/3 of dentine (before Degree 4) and opting for non-invasive methods [6, 7]. Evidence suggests that the presence of radiolucency in the middle or deeper third of dentin is a reliable indicator that the tooth surface is cavitated and the enamel or dentin is heavily infected. This corresponds to scores 4 (D5), 5 (D6) and 6 on the ICCMS™ radiographic scoring system [2]. There is no consensus for primary teeth, but their faster caries progression and shorter enamel-dentine-pulp distance may necessitate earlier RT criteria [25, 26].

For both permanent tooth and primary tooth scenarios, more

than half of the participants stated that they would intervene before the lesion crossed the dentine border. In Scenario 1,

TABLE 4. Preparation method selections according to demographic characteristics and treatment routines of groups in Scenario 1.

	GD				RDTS			
	Traditional Class II N (%)	Box N (%)	Tunnel N (%)	*p*	Traditional Class II N (%)	Box N (%)	Tunnel N (%)	*p*
Gender								
Female	25 (22.4)	65 (58.0)	22 (19.7)	0.919	7 (31.8)	15 (68.2)	7 (31.8)	0.990
Male	13 (24.6)	29 (54.8)	11 (20.8)		2 (33.3)	4 (66.7)	2 (33.3)	
Type of practice								
Public	6 (7.6)	48 (60.8)	25 (31.6)		1 (100.0)	-	1 (100.0)	
Private	32 (37.2)	46 (53.5)	8 (9.3)	0.001*	-	1 (100.0)	-	0.540
University	-	-	-		8 (30.8)	18 (69.2)	8 (30.8)	
Professional Experience (yr)								
0–2	20 (35.1)	32 (56.1)	5 (8.8)		-	-	-	
3–5	8 (17.0)	30 (63.8)	9 (19.1)	0.008*	1 (50.0)	11 (50.0)	1 (50.0)	0.990
6–10	3 (12.5)	10 (41.7)	11 (45.8)		5 (31.3)	11 (68.8)	5 (31.3)	
≥11	7 (18.9)	22 (59.5)	8 (21.6)		3 (30.0)	7 (70.0)	3 (30.0)	
Avg. Restoration (Number)								
1–5	28 (36.8)	38 (50.0)	10 (13.2)		-	2 (25.0)	6 (75.0)	
6–10	10 (15.9)	39 (61.9)	14 (22.2)	0.0001*	-	4 (26.7)	11 (73.3)	0.417
11–15	-	17 (77.8)	9 (34.6)		-	3 (60.0)	2 (40.0)	
≥16	-	4 (50.0)	4 (50.0)		-	2 (25.0)	6 (75.0)	

GD: General Dentist; RDTS: Restorative Dental Treatment Specialists; Avg. Restoration: Average Number of Restorations Per Day.

**: p value < 0.05 considered significant.*

TABLE 5. Distribution of RT and preparation method choices by participant groups in Scenario 2.

	D1 + D2 N (%)		D3 N (%)	D4 N (%)	D5 + D6 N (%)		*p*	Traditional N (%)	Box N (%)	Tunnel N (%)
GD	D1 4 (2.4)	24 (14.5)	68 (41.2)	31 (18.8)	D5 22 (13.3)	42 (25.5)		63 (38.2)	89 (54.0)	13 (7.8)
	D2 20 (12.1)				D6 20 (12.1)					
PD	D1 6 (6.5)	22 (23.9)	36 (39.1)	22 (23.9)	D5 6 (6.5)	12 (13.0)		21 (22.8)	61 (66.3)	10 (10.9)
	D2 16 (17.4)				D6 6 (6.5)		0.551			
RDTS	D1 1 (3.6)	1 (3.6)	8 (28.6)	11 (39.3)	D5 5 (17.9)	8 (28.6)		4 (14.3)	23 (82.1)	1 (3.6)
	D2 -				D6 3 (10.7)					
Student	D1 4 (6.7)	12 (20.0)	21 (35.0)	20 (33.3)	D5 4 (6.7)	7 (11.7)		12 (20.0)	42 (70.0)	6 (10.0)
	D2 8 (13.3)				D6 3 (5.0)					
Total	D1 15 (4.3)	59 (17.1)	133 (38.5)	84 (24.3)	D5 37 (10.7)	69 (20.0)		100 (29.0)	215 (62.3)	30 (8.7)
	D2 44 (12.8)				D6 32 (9.30)					

GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists.

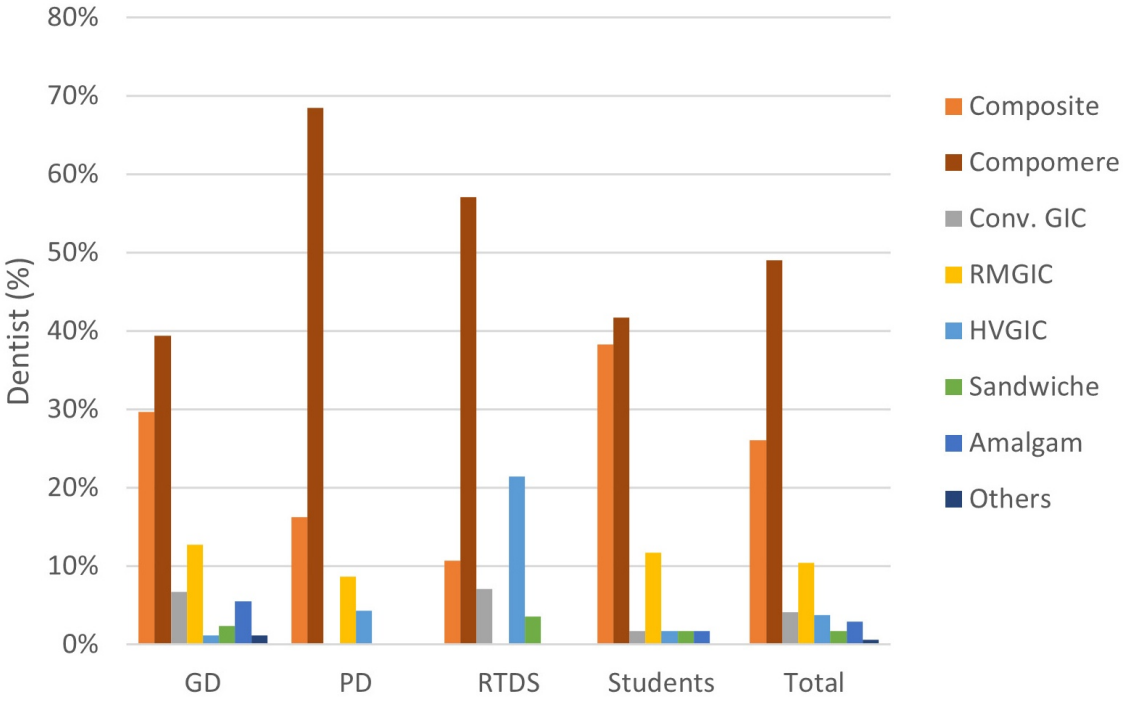


FIGURE 3. Participants' material selection in scenario 2. GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists; Conv.GIC: conventional glass ionomer; RMGIC: resin-modified glass ionomer cement; HVGIC: high viscosity glass ionomer.

1 in 5 participants decided to intervene when the lesion was still enameled. According to a meta-analysis conducted by Innes and their team, 21% of dentists and therapists addressed enamel-limited proximal caries, while almost half treated lesions that had reached EDJ. The worldwide prevalence reported in this meta-analysis is comparable to the rates found in our research [19]. The rates of early intervention of the dentists participating in our study in immature permanent and primary tooth cases were 59.1% and 55.6%, respectively. Keys [20], 2019 study found significantly lower rates of early intervention among participants (27.5% for permanent teeth and 41.1% for primary teeth), indicating that Australian clinicians were more conservative in their treatment decisions compared to their Turkish counterparts. In contrast, early intervention rates were notably higher in France [22] (68% for permanent teeth and 75% for primary teeth) and Canada [21] (68% for primary teeth), exceeding the rates observed in our study. Northern European countries exhibited the lowest rates of intervention for carious lesions [5]. The proportion of early intervention decisions made by final-year dental students in the study was notably higher than that of their Brazilian [27] counterparts (permanent teeth: 38.1%, primary teeth: 28.5%), but lower than that of Russian [28] students (82.7% for permanent teeth). Considering the relatively limited clinical exposure and the presumed reliance on foundational education among the student groups, these findings may reflect variations in the contemporariness of dental curricula across different nations.

Pediatric dentists were the first to intervene in both scenarios. Unlike studies in California [17] and France [22] where pediatric dentists intervened later than GD, our study and those in Australia and New Zealand [20] found pediatric dentists intervene earlier. The prevalence of caries in the Turkish population is 76.5%, with mean DMFT/dmft scores for the 5-year and 15-year age groups are 3.64 and 2.72 [29]. Studies have shown that the progression rate of carious lesions, especially in the interface, is significantly faster in adolescents compared to adults. This finding highlights the need for earlier invasive interventions in adolescents compared to adults [30]. When the progression rate of caries is high, cavitation can occur as soon as the decay reaches the dentin [2]. Given the high prevalence of caries and poor oral hygiene, early intervention decisions may be more common in Turkish dental practice. This tendency may be more pronounced among pediatric dentists who frequently treat young children and those at high risk for caries. The fact that the rate of early intervention by RDTS in proximal caries in our study in our study was much lower than in the other groups supports the view that specialized training in cariology and its treatment may prevent excessive restorative treatment. When all groups are examined, the distribution of threshold selections in both permanent and primary teeth in proximal caries is quite similar. When deciding on restorative treatment, dentists may conclude that the permanence or current function of the tooth is not very important, and that the priority is to treat the caries.

In the second clinical case question, the choice of preparation technique, the majority of the participants preferred conservative methods in both cases (80.3%, 71%). One of the findings of our study is that traditional class II preparation was more common in primary teeth than in immature permanent teeth. Clearly, the expert participants were more likely to adhere to the principles of MID during restorative intervention, with box-only preparation being the most popular choice. This is consistent with similar studies [20, 21]. Tunnel preparation, another conservative option in the questionnaire, was the least

TABLE 6. RT choices according to demographic characteristics and treatment routines of the groups in Scenario 2.

	GD					PD					RDTS				
	D1 + D2 N (%)	D3 N (%)	D4 N (%)	D5 + D6 N (%)	*p*	D1 + D2 N (%)	D3 N (%)	D4 N (%)	D5 + D6 N (%)	*p*	D1 + D2 N (%)	D3 N (%)	D4 N (%)	D5 + D6 N (%)	*p*
Gender															
Female	11 (9.8)	46 (41.1)	25 (22.3)	30 (26.8)	0.048*	21 (28.0)	23 (30.7)	22 (29.3)	9 (12.0)	0.001*	1 (4.5)	5 (22.7)	8 (36.4)	8 (36.4)	-
Male	13 (24.5)	22 (41.5)	6 (11.3)	12 (22.6)		1 (5.9)	13 (76.5)	-	3 (17.6)		-	3 (50.0)	3 (50.0)	-	
Type of practice															
Public	14 (17.7)	27 (34.2)	16 (25.8)	22 (20.3)		1 (8.3)	3 (25.0)	3 (25.0)	5 (41.7)		-	1 (100.0)	-	-	
Private	10 (11.6)	41 (47.7)	15 (17.4)	20 (23.3)	0.336	5 (20.8)	7 (29.2)	9 (37.5)	3 (12.5)	0.030*	-	-	-	1 (100.0)	-
University	-	-	-			16 (28.6)	26 (46.4)	10 (17.9)	4 (7.1)		1 (3.8)	7 (26.9)	11 (42.3)	7 (26.9)	
Professional Working Experience (yr)															
0–2	4 (7.0)	27 (47.4)	14 (24.6)	12 (21.1)		9 (25.7)	9 (25.7)	10 (28.6)	7 (20.0)		-	-	-	-	
3–5	9 (19.1)	22 (46.8)	6 (21.3)	10 (21.3)	0.251	3 (10.7)	18 (64.3)	5 (17.6)	2 (7.1)	0.438	-	-	2 (100.0)	-	-
6–10	3 (12.5)	7 (29.2)	5 (20.8)	9 (37.5)		3 (42.9)	1 (14.3)	1 (14.3)	2 (28.6)		-	5 (31.3)	5 (31.3)	6 (37.5)	
≥11	8 (21.6)	12 (32.4)	6 (16.2)	11 (29.7)		7 (31.8)	8 (36.4)	6 (27.3)	1 (4.5)		1 (10.0)	3 (30.0)	4 (40.0)	2 (20.0)	
Avg. Restoration (Number)															
1–5	13 (17.1)	32 (42.1)	13 (17.1)	18 (23.7)		5 (17.3)	17 (58.6)	4 (13.8)	3 (10.3)		1 (12.5)	2 (25.0)	3 (37.5)	2 (25.0)	
6–10	6 (9.5)	28 (44.4)	13 (20.6)	16 (25.4)	0.740	13 (27.0)	15 (31.3)	14 (29.2)	6 (12.5)	0.274	-	4 (26.7)	5 (33.3)	6 (40.0)	-
11–15	5 (19.2)	8 (30.8)	5 (19.2)	8 (30.8)		4 (26.7)	4 (26.7)	4 (26.7)	3 (20.0)		-	2 (40.0)	3 (60.0)	-	
≥16	-	-	-	-		-	-	-	-		1 (12.5)	2 (25.0)	3 (37.5)	2 (25.0)	
Treatment Frequency															
Often	4 (11.4)	14 (40.0)	6 (17.1)	11 (31.4)		-	-	-	-		-	-	-	-	
Sometimes	15 (13.2)	50 (43.9)	22 (19.3)	27 (23.7)	0.538	-	-	-	-	-	1 (6.7)	7 (46.7)	4 (26.7)	3 (20.0)	-
None	5 (31.3)	4 (25.0)	3 (18.8)	4 (25.0)		-	-	-	-		-	1 (7.7)	7 (53.8)	5 (38.5)	
Position															
Specialist	-	-	-	-		6 (19.4)	9 (29.0)	10 (32.3)	6 (19.4)						
Academician	-	-	-	-	-	7 (21.2)	19 (57.6)	6 (18.2)	1 (3.0)	0.083					-
Spec. Stu.	-	-	-	-		9 (32.1)	8 (28.6)	6 (21.4)	5 (17.9)						

GD: General Dentist; PD: Pediatric dentists; RDTS: Restorative Dental Treatment Specialists; Avg. Restoration: Average Number of Restorations Per Day; Spec. Stu.: Specialization Student.

**: p-value < 0.05 considered significant.*

TABLE 7. Distribution of participants' preparation choices in Scenario 2.

	GD				Pediatric dentist				RDTS			
	Traditional Class II N (%)	Box N (%)	Tunnel N (%)	*p*	Traditional Class II N (%)	Box N (%)	Tunnel N (%)	*p*	Traditional Class II N (%)	Box N (%)	Tunnel N (%)	*p*
Gender												
Female	44 (39.3)	61 (54.5)	7 (6.3)	0.560	17 (22.7)	49 (65.3)	9 (12.0)	0.920	4 (18.2)	17 (77.3)	1 (4.5)	-
Male	19 (35.8)	28 (52.8)	6 (11.3)		4 (23.5)	12 (70.6)	1 (5.9)		-	6 (100.0)	-	
Type of practice												
Public	31 (39.2)	39 (49.4)	9 (11.4)		4 (33.3)	8 (66.7)	-		1 (100.0)	-	-	
Private	32 (37.2)	50 (58.1)	4 (4.7)	0.237	10 (41.7)	13 (54.2)	1 (4.2)	0.020*	3 (11.5)	22 (84.6)	1 (3.8)	0.330
University	-	-	-		7 (12.5)	40 (71.4)	9 (16.1)		-	1 (100.0)	-	
Professional Experience (yr)												
0–2	14 (24.6)	42 (73.7)	1 (1.8)		-	7 (100.0)	-		-	-	-	
3–5	18 (38.3)	25 (53.2)	4 (8.5)	0.0001*	2 (9.1)	16 (72.1)	4 (18.2)	0.030*	-	2 (100.0)	-	-
6–10	8 (33.3)	13 (54.2)	3 (12.5)		8 (22.9)	23 (65.7)	4 (11.4)		2 (12.5)	13 (81.3)	1 (6.3)	
≥11	23 (62.5)	9 (24.3)	5 (13.5)		11 (39.3)	15 (53.6)	2 (7.1)		2 (20.0)	8 (80.0)	-	
Avg. Restoration (Number)												
1–5	25 (32.9)	46 (60.5)	5 (6.6)		7 (24.1)	19 (65.5)	3 (10.3)		2 (25.0)	6 (75.0)	-	
6–10	23 (36.5)	33 (52.4)	7 (11.1)	0.187	10 (20.8)	33 (68.8)	5 (10.4)	0.950	2 (13.3)	13 (86.7)	-	-
≥11	15 (57.7)	10 (38.5)	1 (3.8)		4 (26.7)	9 (60.0)	2 (13.3)		-	4 (80.0)	1 (20.0)	
Treatment Frequency												
Often	17 (48.6)	16 (45.7)	2 (5.7)		-	-	-		-	-	-	
Sometimes	44 (38.6)	63 (55.3)	7 (6.1)	0.033*	-	-	-	-	2 (13.3)	12 (80.0)	1 (6.7)	0.990
None	2 (12.5)	10 (62.5)	4 (25.0)		-	-	-		2 (15.4)	11 (84.6)	-	
Position												
Specialist	-	-	-		12 (38.7)	18 (58.1)	1 (3.2)					
Academician	-	-	-	-	7 (21.2)	22 (66.7)	4 (12.1)	0.033*				-
Spec. Stu.	-	-	-		2 (7.1)	21 (75.0)	5 (17.9)					

GD: General Dentist; RDTS: Restorative Dental Treatment Specialists; Avg. Restoration: Average Number of Restorations Per Day; Spec. Stu.: Specialization Student.
**: p value < 0.05 considered significant.*

preferred for both case scenarios, regardless of group. Despite being a conservative approach for proximal caries, tunnel restoration is a technique-sensitive procedure that necessitates a high level of clinical expertise [31]. In the permanent tooth scenario, tunnel preparation was the most preferred method of RDTSs (64%). In a questionnaire study conducted in France with the participation of academicians in the department of operative dentistry, it was determined that the participants most often chose the tunnel preparation method in the restoration of permanent proximal caries [32]. The results support the results of our study. The study suggests that RDTSs may prefer to perform tunnel preparation on immature permanent teeth because of their confidence that tunnel restorations will not fail due to iatrogenic causes due to their specialized training. RDTSs showed an increased preference for both box-only and traditional preparations in primary teeth compared to permanent teeth. This may be attributed to their limited experience with primary teeth and specialized training in permanent dental treatments, leading to distinct decision-making patterns in these cases. The students, on the other hand, mostly chose traditional preparation, which may be due to their lack of experience, insecurity regarding caries management and practical applications. Traditional Class II preparations, which can significantly remove healthy tooth tissue, are typically used for restorative materials requiring mechanical retention. However, advancements in dental materials and adhesive systems have reduced the necessity for mechanical retention. Therefore, there is no justification for the use of traditional techniques, especially in the treatment of caries [33]. More participatory opinions are needed to determine the exact sources of dentists' decisions on this issue.

In this study, we tried to examine whether some basic factors for dentists are effective in their decision-making. In doing so, we did this by separating them according to their areas of specialization, because we believe that it would not be appropriate to evaluate them as a single group, considering their continuing specialization training and duration after their undergraduate education.

In our study, we found that gender in particular may affect the RT decision. In line with our study, there are also studies that find a relationship between gender and RT decisions [20, 34, 35]. In both scenarios, as the professional years of the GDs increased, the rates of choosing traditional preparation increased. In primary teeth, as professional years of the pediatric dentists increased the rates of traditional preparation preference increased. There was a significant difference between the positions of the pediatric dentists in the choice of tunnel preparation. Pedodontics trainees were more likely to prefer tunnel preparation than specialist pediatric dentists. Considering that we can say that as clinical experience increases, we can say that there is a tendency towards traditional preferences from conservative preferences such as tunnel. Kopperud *et al.* [36] reported that the preference for traditional preparations for occlusal caries increased as the age of Norwegian dentists increased. This result coincides with the findings of our study.

The study found that GDs and pediatric dentists working in private institutions, as well as pediatric dentists in university, were more likely to intervene early in caries lesions and prefer traditional preparation methods more than those in public institutions. There are studies suggesting that dentists working in practices with low patient volume and/or financial pressure are more likely to opt for aggressive and excessive treatments [37]. Moreover, dentists in private practice may have selected more classic preparation techniques to enhance the longevity and durability of restorations by providing additional retention and thereby reducing the risk of secondary caries.

In both scenarios, academics within the pediatric dentists group choose to intervene early at a much higher rate than specialist pediatric dentists and pediatric dentist candidates. In children, many factors such as tooth maturation, ease of plaque retention during eruption, occlusal morphology of teeth without physiological wear, and high dentine permeability prevent progression in immature permanent teeth from being as predictable as in adults [38–40]. This difference may be among the main reasons why academics chose to intervene earlier.

The study by El-Mowafy *et al.* [41] identified several factors influencing dentists' treatment decisions, including gender, experience, university, institution type, appointment time, and number of restorative procedures per day. Among the GD participants in our study, and the preference for box-only preparation increased as the number of restorative procedures per day increased. It is quite possible that the reasons for this choice include saving time and ease of application.

The institutions where the participants worked influenced RT decisions and the choice of preparation methods. The early intervention decisions of pediatric dentists working in private institutions and universities were higher than those of pediatric dentists working in public institutions in both scenarios. Especially in dentists working in private institutions, concerns such as economic concerns and patient satisfaction may increase the decision to intervene early in lesions. In addition, especially in universities, reasons such as long appointment queues, patients not being able to reach the physician easily, and patients not coming to the controls may also be reasons for early intervention. This difference may be among the main reasons why academics choose to intervene earlier. In the health system in our country, university hospitals are within the scope of tertiary health institutions. The patient's profile is usually highly specialized conditions and uncooperative or very young children. In the advanced stages of caries lesions, emergency treatments that may be required are a difficult treatment process for pediatric patients. These situations, which academics frequently encounter, may encourage them to intervene at an early stage in order to minimize the problems that may occur.

Composite material is the most preferred material in all groups for the restoration of proximal caries of immature permanent teeth (Scenario 1). Similarly, in many studies, the most preferred material has been composite [16, 20, 21, 28, 35]. Amalgam was the least preferred material. In permanent teeth, amalgam was preferred only by GDs. Amalgam has become a less needed material with the development of adhesive materials and increasing aesthetic expectations. Since the mercury in its content is a harmful substance to the environment, it is less preferred by dentists. In the restoration of the proximal of primary teeth, dentists preferred compomer the most and composite the second most. Compomer is the most successful material after SSC in primary tooth restorations

[42]. On the other hand, there are studies that have found composite restorations in primary teeth to be successful [42, 43]. The sandwich technique option was the least preferred restorative material in scenarios 1 and 2, as in most of the similar studies [20, 44, 45]. The primary reason why dentists in the study preferred adhesive material and modified GIC more than sandwich technique may be that they have more condense in a monoblock restoration. When all cases were analyzed, RDTSs were the most preferred group for GIC materials, especially RMGIC and HVGIC. RDTSs preferred a wide variety of materials. In primary teeth, compomer was mostly preferred by pediatric dentists. We think that the differences in the selection of materials between specializations are due to the differences in education-material knowledge.

As the study was conducted in a single center and based on an online survey, the number of participants remained relatively limited. Since the case scenarios were hypothetical, the responses were also hypothetical in nature. Although the participants' answers reflect their clinical perspectives, various factors during actual practice may lead to discrepancies between stated opinions and real-life applications. Therefore, the findings may not fully represent actual clinical outcomes.

5. Conclusions

In conclusion, when the scenarios were analyzed, it was concluded that dentists tended to intervene early in proximal carious lesions. Pediatric dentists had higher rates of early intervention than other groups. Various factors such as gender, professional years, and type of institution affect the choice of RT and preparation method. Consequently, the null hypothesis was partially rejected. In immature permanent teeth and primary teeth, dentists prefer conservative preparation techniques to preserve healthy tooth tissue. In restorative dental treatments, dentists primarily prefer resin-containing materials for both permanent and primary teeth. To reduce excessive and premature interventions in dentistry, implementing a fee-for-service system for non-invasive interventions such as caries lesion monitoring, caries risk assessment, and dietary management could incentivize dentists to prioritize preventive and conservative treatments over early and invasive procedures. Continuous professional development through regular training can also help reduce the frequency of premature and excessive interventions. Adopting public oral health improvement policies, as seen in Northern European countries, can further contribute to addressing this issue. Widespread implementation of MID practices in undergraduate dental programs can also serve as an alternative solution. This study is the first study in Türkiye to question the restoration threshold of dentists regarding the proximal caries of primary and immature permanent teeth. Further studies on this issue are also needed.

AVAILABILITY OF DATA AND MATERIALS

The data used to support the findings of this study can be made available upon request to the corresponding author.

AUTHOR CONTRIBUTIONS

HV and SD—designed the research study; wrote the manuscript. HV—performed the research. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Data for this study were collected at the Department of Pediatric Dentistry, Faculty of Dentistry, Inonu University, Malatya, Türkiye. Ethical approval was obtained from the Inonu University Scientific Research and Publication Ethics Committee (Health Sciences Non-Interventional Clinical Research Ethics Committee) (Approval No: 2021/2073). Informed consent was obtained from all participants prior to the commencement of online questionnaires to ensure adherence to ethical guidelines and respect for participant autonomy.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Desai H, Stewart CA, Finer Y. Minimally invasive therapies for the management of dental caries—a literature review. Dentistry Journal. 2021; 9: 147.

[2] Ismail AI, Pitts NB, Tellez M; Authors of the International Caries C, Management S. The international caries classification and management system (ICCMS™) an example of a caries management pathway. BMC Oral Health. 2015; 15: S9.

[3] Dental Quality Alliance, American Dental Association. Guidance on caries risk assessment in children: a report of the expert panel for use by the dental quality alliance. 2018. Available at: https://www.ada.org/-/media/project/ada-organization/ada/ada-org/files/resources/research/dqa/educational-resources/cra_report.pdf (Accessed: 18 May 2022).

[4] Kühnisch J, Ekstrand K, Pretty I, Twetman S, Van Loveren C, Gizani S, *et al*. Best clinical practice guidance for management of early caries lesions in children and young adults: an EAPD policy document. European Archives of Paediatric Dentistry. 2016; 17: 3–12.

[5] Laske M, Opdam NJM, Bronkhorst EM, Braspenning JCC, van der Sanden WJM, Huysmans MCDNJM, *et al*. Minimally invasive intervention for primary caries lesions: are dentists implementing this concept? Caries Research. 2019; 53: 204–216.

[6] Schwendicke F, Splieth C, Breschi L, Banerjee A, Fontana M, Paris S, *et al*. When to intervene in the caries process? An expert Delphi consensus statement. Clinical Oral Investigations. 2019; 23: 3691–3703.

[7] Ismail AI, Tellez M, Pitts NB, Ekstrand KR, Ricketts D, Longbottom C, *et al*. Caries management pathways preserve dental tissues and promote oral health. Community Dentistry and Oral Epidemiology. 2013; 41: e12–e40.

[8] Mjor IA, Holst D, Eriksen HM. Caries and restoration prevention. Journal of the American Dental Association. 2008; 139: 565–570; quiz 626.
[9] Splieth CH, Banerjee A, Bottenberg P, Breschi L, Campus G, Ekstrand KR, *et al*. How to intervene in the caries process in children: a joint ORCA and EFCD expert Delphi consensus statement. Caries Research. 2020; 54: 297–305.
[10] American Academy of Pediatric Dentistry. Guideline on caries-risk assessment and management for infants, children, and adolescents. Pediatric Dentistry. 2013; 35: E157–E164.
[11] Banerjee A, Frencken JE, Schwendicke F, Innes NPT. Contemporary operative caries management: consensus recommendations on minimally invasive caries removal. British Dental Journal. 2017; 223: 215–222.
[12] Lussi A, Buzalaf MAR. Caries excavation: evolution of treating cavitated carious lesions. In Schwendicke F, Frencken J, Innes N (eds.) Monographs in oral science (pp. 56–161). Karger Medical and Scientific Publishers: Basel. 2018.
[13] Schwendicke F, Frencken JE, Bjorndal L, Maltz M, Manton DJ, Ricketts D, *et al*. Managing carious lesions: consensus recommendations on carious tissue removal. Advances in Dental Research. 2016; 28: 58–67.
[14] Espelid I, Tveit AB, Haugejorden O, Riordan PJ. Variation in radiographic interpretation and restorative treatment decisions on approximal caries among dentists in Norway. Community Dentistry and Oral Epidemiology. 1985; 13: 26–29.
[15] Espelid I, Tveit AB, Mejàre I, Sundberg H, Hallonsten AL. Restorative treatment decisions on occlusal caries in Scandinavia. Acta Odontologica Scandinavica. 2001; 59: 21–27.
[16] Khalaf ME, Alomari QD, Ngo H, Doméjean S. Restorative treatment thresholds: factors influencing the treatment thresholds and modalities of general dentists in Kuwait. Medical Principles and Practice. 2014; 23: 357–362.
[17] Rechmann P, Doméjean S, Rechmann BM, Kinsel R, Featherstone JD. Approximal and occlusal carious lesions: restorative treatment decisions by California dentists. Journal of the American Dental Association. 2016; 147: 328–338.
[18] Ruiz B, Urzúa I, Cabello R, Rodríguez G, Espelid I. Validation of the Spanish version of the "questionnaire on the treatment of approximal and occlusal caries". Clinical Oral Investigations. 2013; 17: 29–35.
[19] Innes NPT, Schwendicke F. Restorative thresholds for carious lesions: systematic review and meta-analysis. Journal of Dental Research. 2017; 96: 501–508.
[20] Keys T, Burrow M, Rajan S, Rompre P, Doméjean S, Muller-Bolla M, *et al*. Carious lesion management in children and adolescents by Australian dentists. Australian Dental Journal. 2019; 64: 282–292.
[21] Moreau A, Dumais S, Nguyen C, Rompré P, Vu D. Clinical management of interproximal and occlusal caries in children and adolescents by Canadian dentists: a survey. Journal of the Canadian Dental Association. 2022; 88: m3.
[22] Muller-Bolla M, Aïem E, Coulot C, Velly AM, Doméjean S. Restorative thresholds for primary and permanent molars in children: French dentist decisions. International Journal of Paediatric Dentistry. 2021; 31: 299–310.
[23] Pitts NB, Ismail AI, Martignon S, Ekstrand K, Douglas GV, Longbottom C. ICCMS™ guide for practitioners and educators. 2014. Available at: https://www.iccms-web.com/uploads/asset/59284654c0a6f822230100.pdf (Accessed: 20 May 2022).
[24] Martignon S, Pitts NB, Goffin G, Mazevet M, Douglas GVA, Newton JT, *et al*. CariesCare practice guide: consensus on evidence into practice. British Dental Journal. 2019; 227: 353–362.
[25] Mejàre I, Källestål C, Stenlund H. Incidence and progression of approximal caries from 11 to 22 years of age in Sweden: a prospective radiographic study. Caries Research. 1999; 33: 93–100.
[26] Mejàre I, Stenlund H, Julihn A, Larsson I, Permert L. Influence of approximal caries in primary molars on caries rate for the mesial surface of the first permanent molar in Swedish children from 6 to 12 years of age. Caries Research. 2001; 35: 178–185.
[27] Bervian J, Tovo MF, Feldens CA, Brusco LC, Rosa FMd. Evaluation of final-year dental students concerning therapeutic decision making for proximal caries. Brazilian Oral Research. 2009; 23: 54–60.
[28] Drachev SN, Galieva AS, Yushmanova TN, Polivanaya EA, Stangvaltaite-Mouhat L, Al-Mahdi R, *et al*. Restorative treatment decisions for carious lesions: do Russian dentists and dental students apply minimal intervention dentistry? BMC Oral Health. 2021; 21: 638.
[29] Orhan AI, Alkan A, Orhan K, Tezel A, Karaoglanoglu S, Oztas D. Dental caries and associated factors among Turkish children and adults: findings from the 3rd National Oral Health Survey. Community Dentistry and Oral Epidemiology. 2024; 52: 499–508.
[30] Mejàre I, Stenlund H, Zelezny-Holmlund C. Caries incidence and lesion progression from adolescence to young adulthood: a prospective 15-year cohort study in Sweden. Caries Research. 2004; 38: 130–141.
[31] Nizami MZI, Yeung C, Yin IX, Wong AWY, Chu CH, Yu OY. Tunnel restoration: a minimally invasive dentistry practice. Clinical, Cosmetic and Investigational Dentistry. 2022; 14: 207–216.
[32] Doméjean-Orliaguet S, Tubert-Jeannin S, Riordan PJ, Espelid I, Tvoit AB, Tveit AB. French dentists' restorative treatment decisions. Oral Health & Preventive Dentistry. 2004; 2: 125–131.
[33] Frencken JE, Peters MC, Manton DJ, Leal SC, Gordan VV, Eden E. Minimal intervention dentistry for managing dental caries—a review: report of a FDI task group. International Dental Journal. 2012; 62: 223–243.
[34] Ghasemi H, Murtomaa H, Torabzadeh H, Vehkalahti M. Restorative treatment threshold reported by Iranian dentists. Community Dental Health. 2008; 25: 185–190.
[35] Rabi T, Arandi NZ. Restorative treatment decisions regarding approximal and occlusal carious lesions among general dental practitioners in Palestine. Brazilian Journal of Oral Sciences. 2021; 20: e212755.
[36] Kopperud SE, Tveit AB, Opdam NJ, Espelid I. Occlusal caries management: preferences among dentists in Norway. Caries Research. 2016; 50: 40–47.
[37] Ghoneim A, Yu B, Lawrence H, Glogauer M, Shankardass K, Quiñonez C. What influences the clinical decision-making of dentists? A cross-sectional study. PLOS ONE. 2020; 15: e0233652.
[38] Berkovitz BK, Holland GR, Moxham BJ. Oral anatomy, histology and embryology. 5th edn. Elsevier Health Sciences: Amsterdam, The Netherlands. 2017.
[39] Bjørndal L, Reit C, Bruun G, Markvart M, Kjældgaard M, Näsman P, *et al*. Treatment of deep caries lesions in adults: randomized clinical trials comparing stepwise *vs.* direct complete excavation, and direct pulp capping *vs.* partial pulpotomy. European Journal of Oral Sciences. 2010; 118: 290–297.
[40] Chatterjee K. Essentials of dental anatomy & oral histology. 2nd edn. Jaypee Brothers Medical Publishers Ltd: New Delhi. 2014.
[41] El-Mowafy OM, Lewis DW. Restorative decision making by Ontario dentists. Journal of Canadian Dental Association. 1994; 60: 305–310, 313.
[42] Chisini LA, Collares K, Cademartori MG, de Oliveira LJC, Conde MCM, Demarco FF, *et al*. Restorations in primary teeth: a systematic review on survival and reasons for failures. International Journal of Paediatric Dentistry. 2018; 28: 123–139.
[43] Dhar V, Hsu K, Coll J, Ginsberg E, Ball B, Chhibber S, *et al*. Evidence-based update of pediatric dental restorative procedures: dental materials. Journal of Clinical Pediatric Dentistry. 2015; 39: 303–310.
[44] Kakudate N, Sumida F, Matsumoto Y, Manabe K, Yokoyama Y, Gilbert GH, *et al*. Restorative treatment thresholds for proximal caries in dental PBRN. Journal of Dental Research. 2012; 91: 1202–1208.
[45] Suliman A, Abdo A, Elmasmari H. Restorative treatment decisions on approximal caries among practicing dentists in the college of dentistry clinics, Ajman University, United Arab Emirates. The Open Dentistry Journal. 2020; 14: 97–102.

How to cite this article: Handan Vural, Sacide Duman. Factors influencing restorative treatment decisions for proximal caries of primary and immature permanent teeth: a survey. Journal of Clinical Pediatric Dentistry. 2025; 49(5): 105-118. doi: 10.22514/jocpd.2025.105.