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Clinical decision-making in managing deep carious lesions in primary teeth based on clinical experience among pediatric dentists—A cross-sectional study

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ABSTRACT

Objective: To explore the different treatment methods employed in managing deep carious lesions (DCL) of vital primary teeth among pediatric dentists practic.ing in Saudi Arabia. We also want to find out whether the experience of pediatric dentists has any influence on clinical decision-making in managing DCL in primary teeth.

Methods: This online questionnaire-based cross-sectional study was carried out among pediatric dentists practicing in Saudi Arabia. We used a self-administered questionnaire consisting of five sections: demographic data, clinical decisions in managing DCL, clinical protocols, and dentist's knowledge about allowing carious dentin to remain under a restoration. The questionnaire was administrated electronically via SurveyMonkey.

Results: A total of 216 pediatric dentists participated in the study, in which nearly 60% were males. Most dentists reported that they preferred partial caries removal (63%), and the Hall technique (68%) was the mostly practiced method in managing DCL. Nearly 93.5% of the dentists reported performing indirect

pulp capping before placing a permanent restoration, and the most preferred liner was Dycal (60%). About 47.2% of senior dentists reported practicing complete caries removal. Multivariate logistic regression analysis revealed that younger dentists (5–10 years) preferred practiced partial caries excavation two times more often than senior dentists (>10 years).

Conclusions: Pediatric dentists should focus on minimally invasive approaches such as partial caries excavation for DCL treatment. Pediatric dentists, especially senior practitioners, should be educated and trained to adopt minimally invasive strategies in managing DCL, reducing unnecessary risks such as iatrogenic pulpal damage.

Keywords: *deep carious lesions; primary teeth; clinical experience; Saudi Arabia; pediatric dentists.*

INTRODUCTION

Dental caries are widely prevalent and considered the most common noncommunicable disease across the globe.[1,2] Though dental caries is preventive, it was observed that about 50% of children are still having at least one primary tooth with a dental cavity requiring treatment.[3] These cavities, especially the deep carious lesions (DCL), negatively impact children's oral health–related quality of life.[4,5] The management of DCL of primary teeth thus poses a significant challenge to pediatric dentists. During DCL management in the vital teetch, the focus will be on preserving mineralizable tissue, attaining a restorative seal, conserving pulp vitality, and attaining restoration survival for an adequate duration.[6] Different strategies are employed in treating DCL, such as selective caries removal, nonselective caries removal, and the Hall technique.[7] Nevertheless, surveys investigating dental practices showed a significant variability of its implementation in adult patients.[8]

The techniques of DCL treatment have evolved as research progresses, and the method of tackling these lesions is also changing. It is generally found that there is a gap in what evidence recommends and what is practiced in clinical dentistry.[1,9] Because many dentists do not update themselves with the recent research evidence, the techniques of treating deep caries lesions may vary among dentists with different clinical experiences.[8] The two main objectives of this online questionnaire-based cross-sectional survey were as follows: Firstly, to find out the various strategies employed in managing deep caries lesions of vital primary teeth among pediatric dentists practicing in Saudi Arabia. Secondly, to determine whether clinical decision-making in managing DCL in primary teeth varies based on the clinical experience of pediatric dentists practicing in Saudi Arabia.

MATERIALS AND METHDOS

This online questionnaire-based cross-sectional study was carried out among pediatric dentists practicing in Saudi Arabia. We obtained approval from the Institutional Review Board (IRB), Riyadh Elm University, Riyadh. We communicated with all pediatric dentists associated with the Saudi Pediatric Dental Association requesting them to participate in the survey. The information was collected using a self-administered questionnaire obtained from a previous research by Muller-Bolla et al.[10] The questionnaire consisted of five sections which included demographic data (gender, clinical experience, education, country, employment, and type of practice), clinical decisions (management strategies for DCL in healthy primary

teeth), clinical protocols (methods for carious tissue removal, criteria to assess carious tissue removal in DCL, the preferred treatment for an exposed pulp, preferred liner or base material used for different indications), and dentist's knowledge about allowing carious dentin to remain under a restoration based on four questions. The responses to each item were recorded in two ways, closed responses (binary or multiple choice questions) and by using a five-point Likert scale. The questionnaire was administrated anonymously and electronically via SurveyMonkey. All the participants were contacted twice with a gap of a week, requesting them to fill the questionnaire. There was a provision made for informed consent at the beginning of the questionnaire. All emails were sent with a document explaining the purpose of the study.

Statistical analysis was performed using the SPSS Version 20, IBM, Armonk, USA. We computed descriptive statistics such as frequency distributions and percentages to provide an overview of the responses. Study variables were compared between the categories of clinical experience using the chi-square test. Multivariate logistic regression analysis was employed to determine the strength of association between covariates and caries removal technique (partial or complete). The statistical significance was fixed at 5%.

RESULTS

In this study, a total of 330 pediatric dentists were communicated, out of which 216 dentists responded. Nearly 60% of the participants were males. The assessment of their level of education revealed that 50% were pediatric dentists, and about 37% were pursuing postgraduation in pediatric dentistry. When dentists were categorized according to clinical experience, it was found that 37.5% of dentists had less than 5 years of clinical experience, 45.8% dentists had 5 to 10 years of experience, and the remaining 16.7% dentists had more than 10 years of experience. Most of the dentists (90%) were doing specialized practice. Nearly 97% of dentists reported attending the Continuing Dental Education program on primary teeth deep caries management. In DCL, about 63% of dentists responded that they prefer partial caries removal. Hall technique was the treatment choice of 68% of dentists for DCL management. During indirect pulp capping (IPC) treatment after complete caries removal, about 58% of dentists responded that they placed liner below the permanent restoration, and the most preferred liners were Dycal (20%) and glass ionomer cements (GIC) (24%). In cases of partial caries removal, 93.5% of dentists preferred doing IPC before placing a permanent restoration, and the most preferred liner was Dycal (60%). About 89% of dentists reported that they would opt for direct pulp capping treatment to manage iatrogenic pulp exposure during deep caries excavation.

More than 95% of dentists agreed that factors such as the number of caries lesions, patient age, caries risk level, patient cooperation, and frequency of dental visits play a vital role in deciding the DCL treatment strategy. The majority of dentists (60%) reported that it is unnecessary to eliminate all the cariogenic microorganisms while treating DCL, and 80% believed that leaving a certain amount of microorganisms under the restoration will not progress the carious lesion if it is sealed. About 87% of dentists favored the practice of complete caries removal in deep caries lesions. In the case of DCL, 76% of dentists were against the practice of leaving behind infected dentin close to the pulp (Table 1). A statistically significant association was found between the dentist's clinical experience and the technique employed to treat DCL. It is observed that 58.3% of senior dentists with more than 10 years experience preferred spoon excavators for caries excavation. In contrast, only 27 and 35% of dentists with <5 years and 5–10 years of clinical experience, respectively, preferred spoon excavators. More than 30% of dentists with clinical experience between 0 and 10 years reported that they would leave caries while excavating deep dental caries, while only

13.9% of the senior dentists (with >10 years of experience) preferred this method.

The partial caries removal was preferred more (67.9%) by younger dentists (<5 years experience), while only 52–54% of dentists with more than 5 years of experience preferred this technique. Dentists with less than 10 years of experience (69.15–75.8%) also revealed that they practiced the Hall technique more than the senior practitioners (44%). The IPC after the partial caries removal was practiced more among dentists with less than 10 years experience (>95%) compared to senior dentists with >10 years of experience (80%). About 80% of the dentists with less than 10 years of experience believed that certain microorganisms could be left under restoration because the carious lesion will progress if it is sealed. In contrast, only 55.6% of senior dentists agreed to this. Less than 20% of young dentists (<10 years of experience) reported preserving infected dentin close to the pulp to avoid pulp exposure. However, 47% of senior dentists (>10 years experience) said that they would preserve infected dentin (Table 2).

Multivariate logistic regression analysis revealed that the clinical experience and the country of highest degree showed significant association with caries excavation technique (complete and partial). A pediatric dentist who completed their highest degree from Middle East countries preferred partial caries excavation less often (OR 0.45) than dentists who achieved their highest degree from other countries. Younger dentists (5–10 years) preferred practiced partial caries excavation two times more often than senior dentists (>10 years) (Table 3).

DISCUSSION

The DCL in primary dentition causes severe discomfort among children, and treating them poses a significant challenge because of their proximity to the pulp. Many surveys observed that the pediatric dentist opts for a different treatment plan for managing DCL. Many times the strategies employed by pediatric dentists were not supported by scientific evidence. The DCL were always challenging to treat because of their pulp proximity, pain and discomfort, difficulty in tooth isolation, and patient compliance issues, especially in children.[11] Over the past few decades, many researches have been conducted on this topic, and several strategies to treat deep caries lesions were proposed.[1,10,12] Though there are systematic reviews and guidelines for treating these lesions, it was observed that clinicians employ various strategies to treat them.[13] A systematic review by Schwendicke et al. has reported that the caries excavation strategies used by about 50% of dentists were not supported by research evidence.[8]

Our research has revealed that 60–70% of pediatric dentists in Saudi Arabia prefer partial caries removal and specifically practice the Hall's technique. Our study found that about 30% of pediatric dentists still prefer complete caries excavation, which is unnecessary and may cause complications of iatrogenic pulpal exposure. During IPC, 50 and 90% of dentists preferred the use of liners for permanent restoration in complete and partial caries removal, respectively. The most preferred liners were GIC and Dycal after complete caries removal and partial caries removal, respectively. Both Dycal and GIC are shown considerable success when used in close approximation to the pulp.[14] Various dentists consider several factors while deciding the treatment plan for DCL.[13] In this study, more than 90% of dentists agreed that while treating DCL, the following elements were considered: patient age, patient co-operation, frequency of dental visit, and caries risk level.

To the best of our knowledge, this is the first study that assessed the clinical decision-making in managing DCL in primary teeth based on the clinical experience of pediatric dentists. This study revealed that senior pediatric dentists with more than 10 years of experience still practices old treatments for deep caries lesions, such as complete caries removal and spoon excavators. Though there is sufficient evidence supporting partial caries removal (selective

TABLE 1. Descriptive Statistics of the Responses to the Questionnaire.

Questions and responses		**N**	**%**
1: Gender	Male	129	59.7
	Female	87	40.3
2: Level of education	Postgraduate	81	37.5
	Pediatric dentist	108	50.0
	PhD	27	12.5
3: Country in which you obtained your highest degree	Middle East	176	81.5
	Others	40	18.5
4: Clinical experience	Less than 5 years	81	37.5
	5–10 years	99	45.8
	More than 10 years	36	16.7
5: Type of practice	General practice	22	10.2
	Specialized practice	194	89.8
6: Present employment	Academician	19	8.8
	Practitioner	134	62.0
	Both	63	29.2
7: Average number of teeth per day you do restorative procedures	Less than 5 patients	77	35.6
	5–10 patients	116	53.7
	More than 10 patients	23	10.6
8: Have you attended any CDE courses or read any articles on minimal intervention techniques in cariology or restorative dentistry in the recent past?	Yes	210	97.2
	No	6	2.8
9: In a tooth with a deep carious lesion (DCL), which technique would you prefer for removal of demineralized dentin in areas close to the pulp?	No removal of caries	68	31.5
	Carbide burs	57	26.4
	Diamond burs	11	5.1
	Chemical–mechanical	3	1.4
	Spoon excavators	77	35.6
10: Which clinical criteria do you rely on to confirm the satisfactory removal of caries in a DCL in temporary teeth?			
10a: Consistency of dentin	Soft	30	13.9
	Leathery	65	30.1
	Firm	90	41.7
	Hard	31	14.4
10b: Dentin tint	Heavily stained	41	19.0
	Normal to yellow	48	22.2
	Color has no influence on outcome	127	58.8
11: With reference to a DCL in a vital tooth without signs of irreversible pulp involvement, how would you proceed?	Complete caries removal	80	37.0
	Partial caries removal	136	63.0

(continues)

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TABLE 1. Continued

Questions and responses		N	%
12: What do you think about placing a stainless steel according to Hall's technique on a vital temporary tooth with a DCL?			
12a: I perform this technique	Yes	147	68.1
	No	69	31.9
12b: I perform Hall's technique in uncooperative children with DCL as an alternative treatment to excavation procedures	Yes	181	83.8
	No	35	16.2
12c: I apply SDF on a DCL followed by the placement of a stainless steel crown by Hall's technique	Yes	93	43.1
	No	123	56.9
13: Which material do you usually use as a liner under a permanent adhesive restoration for indirect pulp capping (IPC) in the following conditions below?			
13a: Complete caries removal + liner application	Yes	126	58.3
	No	90	41.7
13b: Liner type in complete caries removal	Dycal	44	20.4
	GIC	53	24.5
	MTA	12	5.6
	Others	18	8.3
	None	89	41.2
14a: In case of partial caries removal, before placing permanent restoration, do you perform IPC?	Yes	202	93.5
	No	14	6.5
14b: If Yes, please select the material from the following choices.	Dycal	131	60.6
	GIC	49	22.7
	MTA	21	9.7
	None	15	6.9
15: In the event of iatrogenic pulp exposure during the excavation of caries, what is your treatment choice during the following clinical situations?	Direct pulp capping	24	11.1
	Pulpotomy	192	88.9
16: With respect to your treatment decision, how will you rate the following factors?			
16a: Number of carious lesions	Not important	7	3.2
	Important	209	96.8
16b: Patient age	Not important	2	0.9
	Important	214	99.1
16c: Patient cooperation	Not important	1	0.5
	Important	215	99.5
16d: Caries risk level	Not important	3	1.4
	Important	213	98.6
16e: Frequency of dental visit	Not important	1	0.5
	Important	215	99.5

(continues)

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TABLE 1. Continued

Questions and responses		N	%
16f: Contact between the teeth	Not important	61	28.2
	Important	155	71.8
17: What is your opinion about the following statements related to leaving decayed dentin under restoration?			
17a: Cariogenic microorganisms must be removed, otherwise the carious lesion will progress under the restoration.	No opinion	6	2.8
	Disagree	131	60.6
	Agree	79	36.6
17b: A certain amount of microorganisms can be left under the restoration because the carious lesion will not progress if it is sealed.	No opinion	3	1.4
	Disagree	41	19
	Agree	172	79.6
17c: The carious lesion must be completely removed because it presents a danger to the vitality of the pulp.	No opinion	2	0.9
	Disagree	27	12.5
	Agree	187	86.6
17d: In case of DCL, infected dentin close to the pulp must be preserved to avoid any pulp exposure.	No opinion	5	2.3
	Disagree	164	75.9
	Agree	47	21.8
18: What is your opinion about paradigm shift (present concept) in managing DCL in primary teeth?	Complete caries removal	71	32.9
	Partial caries removal	27	12.5
	Hall technique	20	9.3
	SMART Hall's technique	98	45.4

CDE, Continuing Dental Eduaction; GIC, glass ionomer cement; MTA, mineral trioxide aggegate; SDF, silver diamine fluoride.

caries removal or stepwise caries removal), Hall technique and using Dycal as liner after senior dentists less prefer partial caries removal.[7] There is not much literature to compare our study findings with deep carious lesion treatment strategies based on clinical experience. A global survey among dentists revealed that more than 66% of French and German dentists performed complete excavation even for deep lesions.[15] The US-based study in 2016 also noted that most of the dentists practiced complete caries removal.[16]

The multivariate logistic regression analysis revealed that the country with the highest degree obtained is significantly associated with caries removal techniques. The pediatric dentist graduated from Middle East countries more often preferred invasive procedures (complete caries removal) instead of minimally invasive strategies (partial caries removal). Previous researches evaluating the management of DCL in primary dentition by a pediatric dentist in Middle East countries could not be found in literature. However, a recent survey reported that most dentists in Saudi Arabia preferred the complete removal of caries.[17] In addition, another survey observed that more than 60% of the general dentists in Saudi Arabia received no special education regarding minimally invasive procedures.[18] These findings highlight the need for educating the dentists in Middle East countries about newer evidence-based minimally invasive techniques for caries removal. The regression analysis also showed that dentists with <10 years of clinical

TABLE 2. Association between the Study Variables and Clinical Experience.

Questions and responses		Clinical experience						P-value
		< 5 years		5–10 years		>10 years		
		N	%	N	%	N	%	
9	No removal of caries	25	30.9	38	38.4	5	13.9	0.05*
	Carbide burs	19	23.5	29	29.3	9	25.0	
	Diamond burs	6	7.4	4	4.0	1	2.8	
	Chemical–mechanical	2	2.5	1	1.0	0	0.0	
	Spoon excavators	29	35.8	27	27.3	21	58.3	
10a	Soft	15	18.5	11	11.1	4	11.1	0.01*
	Leathery	28	34.6	28	28.3	9	25.0	
	Firm	32	39.5	47	47.5	11	30.6	
	Hard	6	7.4	13	13.1	12	33.3	
10b	Heavily stained	13	16.0	21	21.2	7	19.4	0.076
	Normal to yellow	15	18.5	19	19.2	14	38.9	
	Color has no influence on outcome	53	65.4	59	59.6	15	41.7	
11	Complete caries removal	26	32.1	37	37.4	17	47.2	0.001*
	Partial caries removal	55	67.9	62	54.6	8	52.8	
12a	Yes	56	69.1	75	75.8	16	44.4	0.003*
	No	25	30.9	24	24.2	20	55.6	
12b	Yes	77	95.1	88	88.9	16	44.4	0.001*
	No	4	4.9	11	11.1	20	55.6	
12c	Yes	37	45.7	46	46.5	10	27.8	0.127
	No	44	54.3	53	53.5	26	72.2	
13a	Yes	48	59.3	59	59.6	19	52.8	0.759
	No	33	40.7	40	40.4	17	47.2	
13b	Dycal	14	17.3	25	25.3	5	13.9	0.489
	GIC	23	28.4	22	22.2	8	22.2	
	MTA	5	6.2	3	3.0	4	11.1	
	None	33	40.7	39	39.4	17	47.2	
14a	Yes	77	95.1	96	97.0	29	80.6	0.002*
	No	4	4.9	3	3.0	7	19.4	
14b	Dycal	44	54.3	70	70.7	17	47.2	0.001*
	GIC	25	30.9	19	19.2	5	13.9	
	MTA	8	9.9	7	7.1	6	16.7	
	None	4	4.9	3	3.0	8	22.2	
15	Direct pulp capping	15	18.5	7	7.1	2	5.6	0.026*
	Pulpotomy	66	81.5	92	92.9	34	94.4	

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TABLE 2. Continued

Questions and responses		Clinical experience						P-value
		< 5 years		5–10 years		>10 years		
		N	%	N	%	N	%	
16a	Not important	2	2.5	3	3.0	2	5.6	0.676
	Important	79	97.5	96	97.0	34	94.4	
16b	Not important	2	2.5	0	0.0	0	0.0	0.186
	Important	79	97.5	99	100.0	36	100.0	
16c	Not important	0	0.0	0	0.0	1	2.8	0.081
	Important	81	100.0	99	100.0	35	97.2	
16d	Not important	2	2.5	0	0.0	1	2.8	0.274
	Important	79	97.5	99	100.0	35	97.2	
16e	Not important	0	0.0	0	0.0	1	2.8	0.081
	Important	81	100.0	99	100.0	35	97.2	
16f	Not important	25	30.9	28	28.3	8	22.2	0.632
	Important	56	69.1	71	71.7	28	77.8	
17a	No opinion	4	4.9	0	0.0	2	5.6	0.039*
	Disagree	42	51.9	63	63.6	26	72.2	
	Agree	35	43.2	36	36.4	8	22.2	
17b	No opinion	1	1.2	2	2.0	0	0.0	0.001*
	Disagree	10	12.3	15	15.2	16	44.4	
	Agree	70	86.4	82	82.8	20	55.6	
17c	No opinion	1	1.2	0	0.0	1	2.8	0.176
	Disagree	12	14.8	8	8.1	7	19.4	
	Agree	68	84.0	91	91.9	28	77.8	
17d	No opinion	2	2.5	2	2.0	1	2.8	0.001*
	Disagree	63	77.8	83	83.8	18	50.0	
	Agree	16	19.8	14	14.1	17	47.2	

GIC, glass ionomer cement; MTA, mineral trioxide aggegate.
*Chi-square test, *Statistically significant at P ≤ 0.05.*

experience practiced partial caries excavation twice (OR 2.3) more often than dentists with >10 years of clinical experience. This finding is supported by the observation of a survey that dentists in Saudi Arabia with <10 years of clinical expertise had more knowledge about the minimum invasive dentistry than senior dentists with >10 years of experience.[18] On the contrary to our findings, previous research among general dentists of Saudi Arabia did not find any association between the years of clinical experience and technique of caries removal.[17] The judgment in the management of DCL is always a difficult task.[19,20] There is sufficient evidence to show that dentists should update their knowledge on the management of deep caries lesions.[20,21] A recent Irish study observed a lack of confidence among the students regarding the management of DCL. The authors suggested that stress and confidence among students play a crucial role.[22] A recent meta-analysis by Tedesco et al. in 2020 has concluded that the

TABLE 3. Multivariate Logistic Regression Analysis.

Details		Complete caries removal		Partial caries removal		P	OR
		N	%	N	%		
Gender	Male	45	56.2	84	61.8	0.51	1.21
	Female	35	43.8	52	38.2		1
Level of education	Postgraduate	32	40.0	49	36.0	0.415	0.77
	Pediatric dentist	48	60.0	87	64.0		1
Highest degree country	Middle East	69	86.2	107	78.7	0.04*	0.45
	Others	11	13.8	29	21.3		1
Type of practice	General	7	8.8	15	11.0	0.59	1.3
	Specialized	73	91.2	121	89.0		1
Present employment	Academician and practitioner	31	38.8	51	37.5	0.55	0.83
	Practitioner	49	61.2	85	62.5		1
Clinical experience	5–10 years	63	78.8	117	86.0	0.4*	2.3
	>10 years	17	21.2	19	14.0		1

**Statistically significant at P ≤ 0.0.5*

Hall Technique is a better treatment option for deep caries lesions in vital teeth.[23] Another systematic review published in 2016 concluded that about 50% of dentists preferred partial caries removal techniques such as selective caries excavation and stepwise caries excavation.[8] Ricucci et al.[24] suggested guidelines to manage deep caries lesions through a conservative approach. This study has certain limitations that needs to be considered before generalizing the results. The response rate was nearly 65% which is one of our significant limitations. There is a possibility of social desirability bias, indicating that the participating dentists prefer minimally invasive approaches, though they do not practice at their clinic.

CONCLUSION

This study highlights that several pediatric dentists still practice conventional procedures such as complete caries removal. The prevalence of aggressive treatment procedures is higher among senior dentists with 10 or more years of experience. There is a need to educate and encourage pediatric dentists to adopt minimally invasive approaches in managing DCL that could reduce unnecessary risks such as iatrogenic pulpal damage.

CONFLICTS OF INTEREST AND FUNDING

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