Original Article

Treatment Preferences of Vital Permanent Teeth with Carious Pulp Exposure: Questionnaire Survey among Dentists in Public Hospitals of Thailand

Chayapol Thumrongjaruwat[2], Busayarat Santiwong[2], Soranun Chantarangsu[3], Pairoj Linsuwanont[1]

[1]Department of Restorative Dentistry, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand

[2]Department of Pediatric Dentistry, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand

[3]Department of Oral Pathology, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand

Abstract

To investigate treatment preferences and factors influencing treatment decisions of vital permanent teeth with carious pulp exposure. An electronic questionnaire was randomly sent to dentists in public hospitals in Thailand. The questionnaire consisted of two parts; 1) four case scenarios with choices of treatment and 2) inquiry of individual participant data. The relationship of the treatment preferences and participants' background characteristics variables were statistically analyzed using the binary multivariable logistic regression analysis. The response rate of this study was 53.3 % (504 out of 1002 dentists). In teeth with reversible pulpitis, the majority of dentists preferred vital pulp therapy (75.8 %), especially direct pulp capping (61.2 %). Pulpectomy (>70 %) was the treatment of choice for teeth with symptomatic irreversible pulpitis. There was no uniform treatment preference of symptomatic immature tooth: apexification (40.8 %), vital pulp therapy (32.2 %) and reference to a specialist (26.9 %). Dentists with postgraduate education preferred vital pulp therapy to apexification in symptomatic immature teeth. In teeth with symptomatic irreversible pulpitis, dentists without experience of root canal treatment on molar teeth preferred to refer cases to a specialist for further treatment. Treatment decisions have been influenced by clinical signs and symptoms and stage of root development. Various factors from participants including age, gender, clinical experiences and postgraduate education affected decision making. Clinical practice guidelines of vital immature tooth with carious pulp exposure is needed to assist dentists in making decisions about appropriate treatment.

Keywords: Carious pulp exposure, Questionnaire survey, Vital pulp therapy

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Correspondence to:

Pairoj Linsuwanont, Department of Operative Dentistry, Faculty of Dentistry, Chulalongkorn University, 34 Henri Dunant Road, Patumwan, Bangkok 10330, Thailand. Tel: 02-218-8795 Email: linspairoj@gmail.com

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Introduction

Management of vital permanent teeth with carious pulp exposure is controversial. Traditionally, pulpectomy has been considered as a reliable treatment providing high successful outcomes.[1] However, the complete removal of vital pulp tissue causes the loss of the proprioception function resulting in the higher incidence of tooth and/or root fracture of endodontically treated teeth in comparison to vital teeth.[2] Alternatively, vital pulp therapy, namely direct pulp capping, partial pulpotomy, or full pulpotomy has been shown to provide successful outcomes in vital permanent teeth with carious pulp exposure.[3]

The concept of vital pulp therapy involves the removal of the inflamed pulp and applying the biocompatible material on the remaining pulp to promote pulpal healing. Case selection is a critical factor influencing treatment outcomes of vital pulp therapy. Clinical signs and symptoms have been suggested as one of the indicative parameters to evaluate the reversible or irreversible status of the pulp.[4] The correlation between clinical diagnosis and histologic findings in teeth with carious pulp exposure was illustrated by Ricucci and co-workers.[5] Spontaneous pain and prolonged pain to thermal stimulus indicate irreversible pulpitis, and brief sensitivity to thermal stimulus indicates reversible pulpitis. Currently, the European Society of Endodontology statement of the management of deep caries and exposed pulp illustrated that vital pulp therapy is recommended in carious-pulp-exposed teeth with either no symptoms or symptoms of reversible pulpitis. It is not considered as a treatment of choice for teeth with irreversible pulpitis.[6] However, clinical signs and symptoms of irreversible pulpitis should not be considered as the contraindication of vital pulp therapy as the demonstration of highly successful outcomes by several studies.[7-9]

A questionnaire survey is an effective tool to collect information from a large group of a targeted population. Especially, where controversy exists, the collected information reveals the extent of the differences and the preferences of the participants. Several survey studies showed variations of treatment decisions of vital permanent teeth with carious pulp exposure.[10-14] Treatment preferences were different among studies regarding management of teeth with symptoms of reversible pulpitis.[10-13] Moreover, to the best of our knowledge, there has been no survey study done investigating the treatment preferences of symptomatic immature teeth with carious pulp exposure.

This study aimed to investigate treatment preferences of vital permanent teeth with carious pulp exposure among dentists in public hospitals of Thailand. The effects of clinical signs and symptoms, the stage of root development and the presence of periapical radiolucency on treatment decisions were examined. In addition, the relationship of treatment preferences and participants' background characteristics were analyzed to reveal factors influencing treatment decisions.

Materials and methods

This study used a web-based questionnaire to investigate treatment preferences of dentists in the public hospitals of Thailand for vital permanent teeth with carious pulp exposure. The questionnaire was developed and tested for its content validity on general dentists, endodontists (dentists with endodontic clinical training) and lecturers from the Department of Community Dentistry, Chulalongkorn University. The Research Ethics Committee of the Faculty of Dentistry, Chulalongkorn University granted the approval on this questionnaire survey (HREC-DCU 2018-078).

In order to obtain the overview perception of dentists in public hospitals in all four regions of Thailand, four provinces from each region of Thailand were randomly selected. A total of sixteen provinces were randomly chosen. Due to the privacy policy, the list of the dental practitioners' email addresses could not be obtained. The head of the public health officers of each selected province were contacted by phone, and were asked to distribute the web-based questionnaire via email to the targeted dentists. Two weeks later, in order to remind non-respondents,

the web-based questionnaires were resent to all targeted dentists with the message "Please complete the questionnaire only if you did not respond to the first survey". A total of 1002 dentists in 16 provinces were included in this study.

On the cover page of the questionnaire, the purposes and expected benefits of the study were clearly stated as well as, detailed instructions on how to complete the questionnaire, the assurance to protect participants' anonymity and the contact details of the researcher (for further inquiry). An electronic questionnaire was constructed in Google Form and consisted of two parts; 1) four case scenarios of vital permanent teeth with carious pulp exposure with choices of treatment 2) inquiry of individual participant data. Four case scenarios were designed to investigate the effect of three factors, namely; 1) Clinical symptoms (reversible pulpitis and irreversible pulpitis), 2) Stage of root development (immature root) and 3) Presence of periapical radiolucency, on the treatment decisions. (Fig. 1)

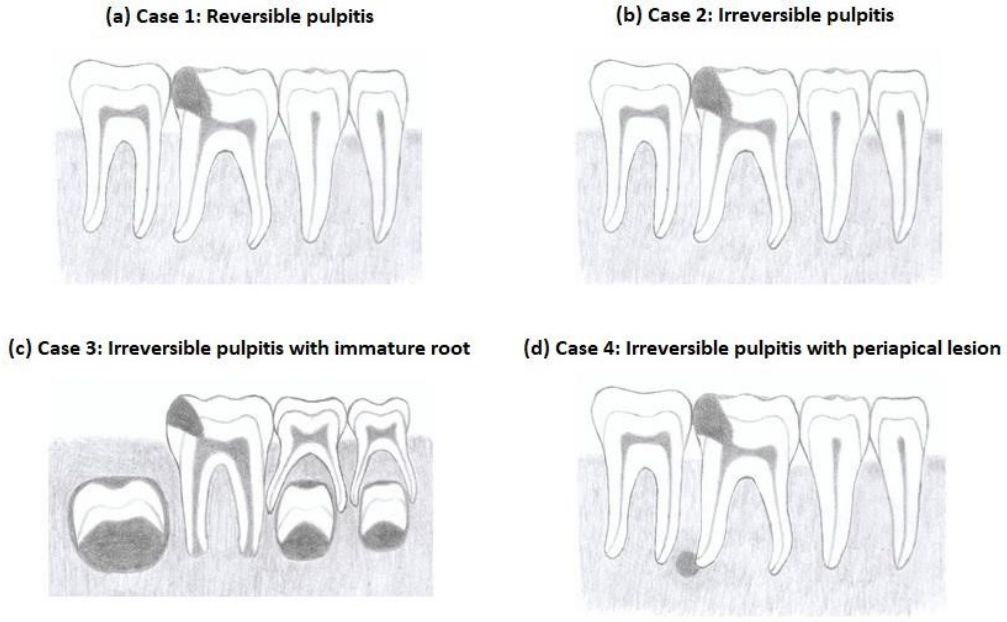

Figure 1 *Case drawings of simulated radiographs for four case scenarios*

Four different simulated clinical cases of lower right first molar with carious pulp exposure including the details of dental history, patients' chief complaints, clinical signs and symptoms and radiographic findings were illustrated. The diagnosis of each case is listed: Case 1. Reversible pulpitis with normal periapical, Case 2. Symptomatic irreversible pulpitis with normal periapical, Case 3. Symptomatic irreversible pulpitis with normal periapical, Case 4. Symptomatic irreversible pulpitis with symptomatic apical periodontitis. Treatment procedures namely; direct pulp capping, partial pulpotomy, full pulpotomy, pulpectomy (or apexification in immature tooth), and reference to specialists were listed. The participants were asked to choose one treatment procedure for each case. In the second part of the questionnaire, participants were asked for the following information: gender, age, experiences in dental practice, postgraduate education and experience in root canal treatment of molar teeth.

Statistical methods

Collected data from Google Form were statistically analyzed using the SPSS program version 23 (IBM SPSS Statistics 23, IBM knowledge center). Descriptive statistics was performed to analyze the participants' background characteristics and the frequency of treatment decisions of each case. Treatment procedures of each case were categorized into three groups namely vital pulp therapy group (inclusive of direct pulp capping, partial pulpotomy and full pulpotomy), pulpectomy (or apexification in immature tooth) group and refer to specialists group for statistics analysis. The relationship of the treatment preference

and participants' background characteristics variables were statistically analyzed. The Chi-square test was used to find out which participants variables influenced treatment preferences. Only the variables which showed the statistically significant value (from Chi-square test) were chosen as independent variables for the binary multivariable logistic regression analysis. A significant level at $p<0.05$ and a 95% confidence interval were set in this study.

Results

A total of 534 of 1002 dentists completed the questionnaires, which provided the response rate of 53.3 %. Of these, 171 dentists responded to the first round of the survey (first response rate = 17.1 %), and 363 dentists responded at the second round (second response rate = 36.2 %). The summary of the background characteristics of the participants is presented in Table 1.

Table 1 *Descriptive data of participants*

Participants factors	No. of participants	%
Gender		
Male	174	32.6 %
Female	360	67.4 %
Age		
≤ 40-year-old	466	87.3 %
> 40-year-old	68	12.7 %
Year in practice		
1-10 yrs	383	71.7 %
≥11 yrs	151	28.3 %
Education qualification		
Bachelor	356	66.7 %
Postgraduate education	178	33.3 %
Experience in root canal therapy of molar teeth		
Yes	332	62.2 %
No	202	37.8 %

The majority of the respondents were female (67.4 %), dentists with the age of less than 40 years-old (87.3 %) and dentists with more than 10 years of experience (71.7 %). Most of the respondents were general practitioners without postgraduate education (66.7 %) and had experience of root canal treatment in molar teeth (62.2 %).

The summary of treatment preferences of each case is presented in Table 2.

Table 2 *Treatment preferences of four simulated clinical cases*

	Vital pulp therapy				Pulpectomy or Apexification in immature teeth	Refer to specialists
	Direct pulp capping	Partial pulpotomy	Full pulpotomy	Sum of Vital pulp therapy		
Case 1:	327	67	11	405	86	43
Reversible Pulpitis	(61.2%)	(12.5%)	(2.1%)	(75.8%)	(16.2%)	(8.0%)
Case 2:	9	32	26	67	375	92
Irreversible pulpitis	(1.7%)	(6.0%)	(4.9%)	(12.6%)	(70.2%)	(17.3%)
Case 3 :	10	96	66	172	218	144
Irreversible pulpitis in immature tooth	(1.9%)	(18.0%)	(12.4%)	(32.2%)	(40.8%)	(26.9%)
Case 4:	0	1	3	4	434	96
Irreversible pulpitis with PA lesion	(0%)	(0.2%)	(0.6%)	(0.8%)	(81.2%)	(18.0%)

For case 1 (teeth with clinical signs and symptoms of reversible pulpitis), vital pulp therapy was the treatment of choice (75.8 %), and direct pulp capping was the most selected treatment procedure (61.2 %). In mature teeth with clinical signs and symptoms of symptomatic irreversible pulpitis with or without periapical radiolucency (case 2 and 4), participants preferred pulpectomy (>70 %) to vital pulp therapy (18 %). There was no uniform treatment preference of an immature tooth with clinical signs and symptoms of symptomatic irreversible pulpitis (case 3). Treatment preferences could be divided into apexification (40.8 %), vital pulp therapy (32.2 %) and reference to a specialist (26.9 %).

For statistical analysis, treatment decisions were categorized into three groups namely, vital therapy group, pulpectomy (or apexification in immature teeth) group and refer to specialists group. The binary logistic regression analysis of the relationship between the participant factors and treatment decisions are shown in Table 3A, B. In case of reversible pulpitis (case 1), young female dentists (age of less than 40-year-old), dentists with less than 10-year-clinical-experience and dentists without experience in root canal treatment in molar teeth preferred vital pulp therapy to pulpectomy. Interestingly, though pulpectomy was the most preferred treatment in case of symptomatic irreversible pulpitis (case 2), dentists with less than 10-year-clinical-experience preferred vital pulp therapy to pulpectomy. In teeth with immature roots with clinical signs and symptoms of symptomatic irreversible pulpitis (case 3), participants with postgraduate education preferred vital pulp therapy to apexification, and general dentists preferred to refer cases to specialists for further treatment. In all four cases, participants with no experience in root canal treatment in molar teeth preferred to refer cases to specialists for further treatment rather than performing pulpectomy/apexification by themselves.

Table 3A *Multivariable binary logistic regression analysis of participants' background characteristics variables on treatment preferences of case 1*

Case 1	VPT vs RCT		VPT vs Refer		RCT vs Refer	
Factors	**OR (95% cl)**	***p*-Value**	**OR (95% cl)**	***p*-Value**	**OR (95% cl)**	***p*-Value**
Gender						
Male	1.75 (1.04-2.94)	0.034*	1.10 (0.56-2.17)	0.763	1.000	
Female	1.00		1.00		1.46 (0.63-3.38)	0.368
Age						
≤40 yrs	1.00		1.21 (0.34-4.30)	0.766	2.75 (0.71-10.62)	0.142
≥40yrs	2.16 (1.07-4.39)	0.030*	1.00		1.00	
Year in practice						
<10yrs	1.00		1.00		2.74 (1.02-7.32)	0.044*
≥10yrs	4.07 (2.20-7.53)	<0.001*	1.54 (0.67-3.50)	0.302	1.00	
Experience in RCT molar						
Yes	1.99 (1.21-3.53)	0.019*	1.00		1.00	
No	1.00		1.18 (0.62-2.230)	0.600	2.85 (1.21-6.68)	0.016*

VPT vital pulp therapy, RCT root canal treatment, Refer refer to specialists

*OR odds ratio, CI confidence interval, * p<0.05*

Table 3B *Multivariable binary logistic regression analysis of participants' background characteristics variables on treatment preferences of case 2, 3*

Case 2	RCT vs VPT		RCT vs Refer		VPT vs Refer	
Factors	**OR (95% cl)**	***p*-Value**	**OR (95% cl)**	***p*-Value**	**OR (95% cl)**	***p*-Value**
Year in practice						
<10yrs	3.23 (1.47-7.08)	0.003*	1.00		1.00	
≥10yrs	1.00		1.38 (0.81-2.36)	0.228	5.00 (1.98-12.6)	0.001*
Experience in RCT molar						
Yes	1.00 (0.56-1.76)	0.9969	1.00	<0.001*	1.00	<0.001*
No	1.00		5.19 (3.12-8.61)		4.68 (2.29-9.57)	
Case 3	**Apexification vs VPT**		**Apexification vs Refer**		**VPT vs Refer**	
Factors	**OR (95% Cl)**	***p*-Value**	**OR (95% Cl)**	***p*-Value**	**OR (95% Cl)**	***p*-Value**
Education						
Bachelor	1.00		1.00		1.69 (1.05-2.73)	0.031*
Higher degree	2.36 (1.54-3.63)	<0.001*	1.26 (0.79-2.04)	0.324	1.00	
Experience in RCT molar						
Yes	1.23 (0.79-1.92)	0.346	1.00		1.00	
No	1.00		2.08 (1.35-3.20)	0.001*	2.57 (1.60-4.11)	<0.001*

VPT vital pulp therapy, RCT root canal treatment, Refer refer to specialists

*OR odds ratio, CI confidence interval, * p<0.05*

Table 3C *Multivariable binary logistic regression analysis of participants' background characteristics variables on treatment preferences of case 4*

Case 4	RCT vs VPT		RCT vs Refer		VPT vs Refer	
Factors	**OR (95% Cl)**	***p*-Value**	**OR (95% Cl)**	***p*-Value**	**OR (95% Cl)**	***p*-Value**
Experience in RCT molar						
Yes	1.36 (0.14-13.39)	0.526	1.00	<0.001*	1.00	0.196
No	1.00		3.36 (2.11-5.35)		4.64 (0.45-47.55)	

VPT vital pulp therapy, RCT root canal treatment, Refer refer to specialists

*OR odds ratio, CI confidence interval, * p<0.05*

Discussion

Web-based questionnaire survey has been considered as an effective and economical tool to collect information from a large group of targeted participants.[15] One of the uncontrollable factors of the web-based survey is the response of the participants. In order to increase the response rate to the present study, the electronic questionnaires were sent twice. The response rate of this survey was 53.3 % (534 out of 1002 dentists), which was comparable with other survey studies (the response rate ranging from 28 % to 56 %).[10,11,13,14]. Since data protection guidelines prohibited the self-identification of respondents, comparison of demographic data between responders and non-responders was not possible in this study. The effect of missing data from a non-responder is unpredictable, and is considered as a limitation for the interpretation of the results of this study.

The decision-making process consists of three phases: diagnosis, decision about intervention and the selection of a treatment.[16] All dentists may not make the same decision when faced with the same clinical situation, especially where there is uncertainty or disagreement concerning the most effective approaches for treatment.[16] Logically, the accuracy of the diagnosis can be influenced by the clinical skills and knowledge of the clinicians. An understanding of the disease, knowledge of the current concept of treatment, and the clinical skills and the experiences including the attitude of the practitioners may all influence the selection of treatment procedures. This illustrates the complexity of influence factors on treatment decisions, which is difficult to simulate in a questionnaire. Moreover, the provided data in the questionnaire is the one-way message from the researcher to the participants, which is different from two-way communication between clinicians and patients in clinical practices. To assure accurate diagnosis and proper treatment procedure in clinical practice, dentists can perform additional tests and discuss treatment options with patients. It is possible that treatment decisions from the survey questionnaires may not be identical to the clinical decisions. Therefore, interpretation of the survey data should be performed with caution. In this study, the rationale to divide responders into various groups was to classify responders into skillful, experienced, level of education and knowledge-updated groups. The selected range of numbers were based on the authors' assumption. Interpretation of the results should be based on this limitation.

Factor of clinical signs and symptoms on treatment decisions

The management of vital permanent mature teeth with carious pulp exposure is controversial. According to the survey studies, when pulp exposure was indicated in restorable vital permanent teeth, treatment decisions have been mainly divided into vital pulp therapy and pulpectomy.[10,12,13] One critical factor influencing treatment decisions is the presence of clinical symptoms. The summary of treatment preferences of teeth with carious pulp exposure with different clinical signs and symptoms are presented in Table 4.[10-14,17]

Table 4 *Summary of treatment preferences of cases with different clinical signs and symptoms from survey studies*

Studies (references)	Asymptomatic	Reversible	Irreversible
Schwendicke *et al.,* 2012[17]	DPC 75%		
Frisk *et al.,* 2013[11]	DPC 66%	DPC 3%	
	Pulpectomy 17%	Partial pulpotomy 6%	
Stangvaltaite *et al.,* 2013[13]	DPC 51%	Pulpectomy 91%	
	Partial pulpotomy 7%		
	Pulpectomy 42%		
Stangvaltaite *et al.,* 2017[14]	DPC 68-93%		
	Partial pulpotomy 0.7-10%		
	Pulpectomy 7-22%		

Table 4 *Summary of treatment preferences of cases with different clinical signs and symptoms from survey studies (cont.)*

Studies (references)	Asymptomatic	Reversible	Irreversible
Koopaeei *et al.,* 2017[12]	DPC 61% Partial pulpotomy 11% Pulpectomy 28%	DPC 4% Partial pulpotomy 17% Pulpectomy 79%	
Croft *et al.,* 2018[10]	DPC 65% Pulpectomy 26%	DPC 42% Pulpectomy 43%	DPC 3% Pulpectomy 94%

DPC Direct pulp capping

Koopaeei et al 201712 pulp exposure with symptoms (not mentioned whether reversible or irreversible pulpitis)

In asymptomatic vital permanent teeth with carious pulp exposure, the survey studies showed that direct pulp capping was the preferred treatment.[10-14,17] Controversy exists in carious-exposed pulp teeth with clinical signs and symptoms of reversible pulpitis. Croft and coworkers showed indifference of treatment preferences between direct pulp capping (42 %) and pulpectomy (43 %).[10] In contrast, pulpectomy was the most preferred treatment (91 %) in the study by Stangvaltaite and coworkers.[13] In the present study, vital pulp therapy (76 %), especially direct pulp capping (61 %), was the preferred treatment. In cases of teeth with clinical signs and symptoms of irreversible pulpitis regardless of the presence of radiolucency, the most selected treatment was pulpectomy as shown in this study and the study by Croft and coworkers.[10]

Analyzing respondents' factors on treatment decisions showed that gender, age, years in practice, experience in root canal treatment in molar teeth and postgraduate education influenced the treatment decisions. Young female dentists (less than 40 years old) preferred the conservative treatment of vital pulp therapy in teeth with clinical signs and symptoms of reversible pulpitis. Similar to Frisk and coworkers, female gender and age group 25-49 years were predictive factors of selection of less invasive treatment options.[11] In the present study, in cases of irreversible pulpitis, dentists without experience of root canal treatment in molar teeth preferred to refer cases to a specialist for further treatment. Dentists may be concerned about the difficulty of pulpectomy in molar teeth with complex root canal anatomy. Interestingly, though pulpectomy was the most preferred treatment in case of symptomatic irreversible pulpitis, dentists with less than ten years of clinical experience preferred vital pulp therapy to pulpectomy. The possible reasons may be the attitude of dentists preferring less invasive treatment and /or to avoid the difficulty of pulpectomy in molar teeth.

Several survey studies showed various factors influencing treatment decisions in teeth with carious pulp exposure.[10-14] The outcome expectation and easy procedure were the main reasons for Norwegian dentists to choose direct pulp capping over pulpectomy in asymptomatic teeth with pulp exposure.[13,14] In the same study, dentists who had access to knowledge on current evidence preferred vital pulp therapy to pulpectomy.[13,14] Interestingly, Koopaeei and coworkers showed that the majority of endodontists (71 %) chose treatment options recommended by clinical research, in comparison with only 45 % of general dentists. Moreover, patients' attitude and the need for further restoration were important factors in the treatment decision-making process.[12]

Factor of the stage of root development on treatment decisions

Literature search showed the lack of survey study investigating treatment preferences of vital immature teeth with carious pulp exposure. This study did not survey the treatment preferences of immature teeth with clinical signs and symptoms of reversible pulpitis. The authors assumed that vital pulp therapy may be the treatment of choice because of the high healing capability of the immature teeth, which can be considered as a flaw of this study. The present study showed that treatment preferences of a symptomatic immature tooth could be divided into

apexification (40.8 %), vital pulp therapy (32.2 %) and reference to a specialist (26.9 %). The variations of treatment preferences may be partly from the lack of consensus clinical guideline on treatment of symptomatic immature teeth with pulp exposure. Interestingly, participants with postgraduate education preferred vital pulp therapy to apexification. The possible reasons could be the better understanding of pulp biology in response to caries and access to current clinical research. In this study, general dentists and dentists without experience in root canal treatment in molar teeth preferred to refer cases to specialists for further treatment. The respondents may not be confident on "which treatment procedure should be selected?" and/or "How to perform the selected treatment".

Current evidence of vital pulp therapy in vital permanent teeth with carious pulp exposure

To date, evidence from clinical studies[7-9] and a systematic review[3,18-20] illustrate the successful outcome of vital pulp therapy on vital permanent teeth with carious pulp exposure. Randomized controlled trial studies showed successful outcome of direct pulp capping[8] and partial pulpotomy[21,22] in vital permanent teeth with clinical signs and symptoms of reversible pulpitis. Recently, the European Society of Endodontology (ESE) published a statement on management of deep caries and exposed pulp. Vital pulp therapy is indicated in vital permanent teeth with carious pulp exposure which exhibit either no symptom or clinical signs and symptoms of reversible pulpitis.[6]

The concept of vital pulp therapy involves the elimination of pulpal inflammation and applying biocompatible material on the remaining pulp to promote pulpal healing. Routinely, pulpal diagnosis relies on the clinical signs and symptoms of the affected tooth. In cases of irreversible pulpitis, the histological examination showed the variations of the extent of pulp inflammation from a small localized area underneath caries to large area of coronal pulp and extending into radicular pulp.[5] Logically, in some cases with localized inflammation, if the localized inflamed pulp is removed, the remaining healthy pulp is capable of healing. Several studies reported the successful outcome of pulpotomy in vital permanent teeth with irreversible pulpitis.[7,23,24] The ESE statement suggests that better long-term prospective randomized data is required before suggesting pulpotomy as the treatment of choice. At this stage, pulpotomy can be performed in teeth with clinical signs and symptoms of irreversible pulpitis only if 1) an aseptic technique is applicable, and 2) in cases where there is partial irreversible pulpitis in the coronal pulp.[6]

A systematic review showed a highly successful outcome (the weighted pooled success of >90%) of vital pulp therapy in immature permanent teeth with carious pulp exposure [3] The expected benefit of further root development as called apexogenesis highlights the advantage of vital pulp therapy over apexification. Case selection has been considered as a critical factor influencing treatment outcome. Most studies limited vital pulp therapy for asymptomatic immature teeth or immature teeth with reversible pulpitis.[25-27] Ricucci and coworkers illustrated that immature teeth with reversible pulpitis showed histological features almost similar to normal teeth in the root canal and the apical region. Those with irreversible pulpitis showed inflammatory reaction in the pulp chamber and/or minor areas of necrosis and bacterial colonization, the absence of odontoblasts on the large area of the canal walls and extremely reduced cellularity of the apical papilla.[28] Traditionally, if the pulp is severely inflamed resulting in the incapability of pulpal healing, apexification or revascularization is indicated. However, several studies demonstrated that pulpotomy in immature permanent teeth with irreversible pulpitis could be successful.[7,24,29,30] For a better understanding of the treatment outcomes of vital pulp therapy in symptomatic immature teeth with carious pulp exposure, more good quality clinical studies is needed.

Conclusion

There is no uniform treatment preference of vital permanent teeth with carious pulp exposure. Treatment decisions were influenced by clinical signs and symptoms, and the stage of root development. Various factors from dentists including age, gender, clinical experiences and

postgraduate education affected their decision making. Clinical practice guidelines of vital immature teeth with carious pulp exposure is needed to assist dentist decisions about appropriate treatment.

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