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A web based survey on knowledge and attitude of cavity disinfection protocol following caries excavation among dental students and practitioners in India

Sai Vignesh Sundara Moorthy, Kavitha Sanjeev, Nagarathinam Sundaramoorthy, * Sekar Mahalaxmi

Department of Conservative Dentistry and Endodontics, SRM Dental College, Ramapuram, SRM Institute of Science and Technology, Chennai, India -600089.

Name: Dr. Sai Vignesh Sundara Moorthy, MDS

Designation: Post graduate

saiviki@gmail.com

Department of Conservative Dentistry and Endodontics

Address: SRM Dental College, Bharathi Salai, Ramapuram, SRM Institute of Science and Technology, Chennai - 600089

Name: Dr. Kavitha Sanjeev, MDS

Designation: Professor

kavithas1@srmist.edu.in

Department of Conservative Dentistry and Endodontics

Address: SRM Dental College, Bharathi Salai, Ramapuram, SRM Institute of Science and Technology, Chennai - 600089

***Name: Dr. Nagarathinam Sundaramoorthy, MDS**

Designation: Assistant Professor

nagarats@srmist.edu.in

Department of Conservative Dentistry and Endodontics

Address: SRM Dental College, Bharathi Salai, Ramapuram, SRM Institute of Science and Technology, Chennai - 600089

***Corresponding author**

Name: Dr. Mahalaxmi Sekar , MDS

Designation: Professor & Head

mahalaxr@srmist.edu.in

Department of Conservative Dentistry and Endodontics

Address: SRM Dental College, Bharathi Salai, Ramapuram, SRM Institute of Science and Technology, Chennai - 600089

Abstract

Purpose: Dental caries is the most prevalent pathology affecting most of the population. Invariably there is possibility of remaining viable bacteria, following removal of decayed tissue, compromising the success of rehabilitation. Cavity disinfection is a key step before any dental restorative procedure. Hence the aim of this web based survey was to assess whether the dental practitioners and students are aware of the importance of cavity disinfection protocol.

Materials & Methods: The questionnaire were based on awareness and attitude towards the use of various disinfection protocols by the dentists.

Results: The results obtained from 320 participants revealed that though awareness prevail among dentists, many do not follow it mandatorily. Among the cavity disinfection agents, many opted for chlorhexidine as their preferred choice.

Conclusion: This survey has exposed the availability of various disinfection protocols available and dictates the mandatory use of cavity disinfection to increase the longevity of the restoration.

Keywords: Cavity disinfection, Chlorhexidine, NaOCl, Laser, Dental Caries

INTRODUCTION

Persistent inflammation due to infected and necrotic hard tissues harboring microorganisms can cause treatment failure and hence complete eradication of these microbial colonies is the primary objective in caries removal[1]. The acid producing bacteria namely *Streptococci* and *Lactobacilli* have been considered as significant ones in contributing to dental caries [2]. The softened dentine is sterile, but the acidity is maintained which endangers the vitality of the pulp. The common delineator is preservation of tissues, ideally preventing disease from occurring, also removing and replacing with as little tissue loss as possible. and intercepting its progress [3]. Based on the evidence, the survival of restorations may doomed to fail if the disease that caused the condition is not addressed properly. In both primary and permanent carious tooth, contemporary dentistry follows stepwise excavation of carious process which will induce self-repair of the underlying tissues while maintaining the vitality of the pulp[4]. During caries excavation, when the microorganisms are not completely eliminated, they may be placed further deep into the dentinal tubules and can multiply and remain viable for a prolonged period of time. This remaining cariogenic bacteria within the dentinal tubules can proceed towards the development of secondary caries[5]. According to Dalkilic *et al*., in a restored cavity, the fermenting microorganisms can remain viable for 139 days and these bacteria along with metabolic products may traverse through the dentinal tubules deep into the underlying tissues causing inflammatory changes in the dental pulp[6]. Minimally invasive procedures are effective in preventing progression of the carious lesion, but the elimination of bacteria that is trapped within the deeper portions pose an additional challenge. Hence, it is imperative to maintain vitality by following meticulous use of effective disinfection agents rather than restoring to endodontic therapy.

Ideally, the entire cavity preparation needs to be performed in a sterile environment and the cariogenic bacteria needs to be completely eradicated, although the practice of retaining softened, uninfected and stained dentine on the floor of a deep cavity is reasoned. Though cavity disinfection is one of the step in cavity preparation, it is most of the time ignored, presuming that the following steps in restorative procedures would satisfy. Unfortunately, procedures practiced in recent years do not completely eliminate all the microorganisms in infected dental tissues[7]. Hence, emphasizing the significance of disinfecting the cavity prior to restoration using chemical or natural agents. This would probably result in total elimination of cariogenic microorganisms, creating a conducive environment for further restorative procedures. Hence the knowledge about this and the ways to eliminate the potential microorganisms should be known to the dentist. Several literatures evidenced the

importance of the use of the cavity disinfection and therefore the success of the restorative procedure.

There always is a disparity between written treatment protocols and actual clinical practice. Whether the clinician judiciously follows all the steps necessary to obtain a totally aseptic restorative field is a million-dollar question. A careful literature search, reveals that there is no evidence of the knowledge and usage of agents for cavity disinfection among dental students or practitioners. Therefore, the objective of this online questionnaire-based survey was to assess the knowledge and attitude towards cavity disinfection procedure following cavity preparation among the students & practitioners residing in India.

MATERIALS AND METHODOLOGY

This survey was approved by the Institutional Review Board (SRMU/M&HS/SRMDC/2021/PG/022). The questionnaire were based on analysis of the awareness and attitude of participants towards cavity disinfection, on demographic data, few pertaining to the awareness of participants and relating to the attitude of participants towards following cavity disinfection protocol. The reliability was assessed by randomly distributing the questionnaire among twenty-five participants at two time intervals, immediately and after 15 days. The sample size obtained from the pilot study with confidence level set at 95% and alpha error set at 5%, was found to be 320 participants.

Statistical analysis and data handling

The questionnaire was developed using Google forms (Google Inc. Mountain View, CA, USA). The data were stored in excel format in the backend until further analysis. The validity and reliability scores for the survey were calculated using Content validity ratio and kappa test respectively. The data was statistically analysed using chi square test. Significant differences was set at 0.05 ($p<0.05$).

RESULTS

The frequency distribution of the survey and the p value amongst the various protocols followed by an individual are represented in Table I and II respectively. Analysis among the study participants (n= 320) revealed that, 80% were aware of the cavity disinfection protocol, while 45% of them followed the disinfection protocol in their practice. Based on the results of the survey, significant difference was noted in the choice of disinfection agents and isolation protocol.

DISCUSSION

The primary management of dental caries consists of removal of infected tissue and subsequent rehabilitation. Several clinical trials with long term follow up demonstrated persistence of cariogenic bacteria under restorations that play an important role in the longevity of the restoration and the tooth [8]. Apart from microleakage and secondary caries,

bacteria present in situ contributes to degradation of adhesive interface of adhesive restorations, and the organic components of teeth questioning the longevity of the restoration [9]. As the oral environment is polymicrobial in nature and identification of new species such as Scardovia wiggsiae in high risk caries individuals, the complete eradication of these species plays a pivotal role [10]. Several bacteriologic studies have shown that complete sterilization following cavity preparation cannot be achieved, and the bacterial left behind remain viable for a long duration of time.

Our national online survey of 320 participants consisting of undergraduates, post graduates and general practitioners, found that though they are aware of disinfection protocol, it is not a part of their treatment. Significant difference was observed in the choice of chemical agents over natural agents. Chlorhexidine followed by sodium hypochlorite (NaOCl) was preferred ($p<0.05$) in comparison to saline. Among the natural agents, significant number of individuals used propolis compared to aloe vera and tea tree oil, while 39% of the individuals were not aware of the natural disinfection substances used. 30%of the practitioners preferred laser for cavity disinfection. Among the lasers suggested, erbium chromium-doped yttrium, scandium, gallium and garnet lasers users were significantly higher compared to diode lasers, though few individuals fall into "not aware" category.

Hence, the results of the survey dictates the importance of knowledge and practise of disinfection protocol. A cavity disinfectant must be bacteriostatic and/or bactericidal, easy to handle, remove and be biocompatible. Most importantly it should disinfect the cavity without compromising the substrate and the restorative procedures. Of the various disinfection agents suggested and used, chlorhexidine seems to meet the criteria as a cavity disinfectant due to its broad spectrum of antibacterial action specially targeting the gram-positive bacteria. Moreover it is reported to increase the bond strength values when used as a pre-rinse before the use of an adhesive, irrespective of the concentration, due to its ability to inhibit collagen degrading enzymes namely MMPs and Cysteine cathepsins. The results of the survey showed that maximum participants use chlorhexidine for cavity disinfection. The choice of chlorhexidine is similar to the meta-analysis in the literature[11]. Hence, as said, it is effective and safe to be used as a cavity disinfection, due to its ability to penetrate deeper inside the dentinal tubules elongating its residual antimicrobial activity.

The next most common choice was NaOCl. It also has the highest antibacterial activity on streptococcus mutans, however due to release of oxygen, it results in incomplete polymerization and subsequently decreased bond strength, questioning the longevity of the tooth-restorative interface[5].

The findings of Lusche et al suggests that laser irradiations eliminate bacteria in deep-layers of dentine unaffecting the smear layer, which would otherwise act as a barrier to various liquid antiseptics [12]. Additionally, it has been reported to positively influence the bond strength of both etch and rinse and self-etch adhesives systems [13]. But, on the other hand, the use of lasers results in increased absorption of energy causing excessive heat in the dentine. The residual thermal energy modify the inorganic and organic content by denaturing and

dehydrating the dentine substrate resulting in large peritubular areas with defective hybridization[14].

Recently there has been a trend to use natural disinfection agents as a part of dental therapeutics termed as "ethnopharmacology" in various domains of dentistry due to its non-toxic and antibacterial properties. Aloe Vera has number of components which possess strong antibacterial and antiviral activities. They exert antimicrobial activity by inhibiting protein synthesis of the bacterial cells and indirectly through stimulation of phagocytosis. The components in propolis namely flavonoids and cinnamic acid are known to be the main biological active compound to exert antimicrobial activities against *Streptococcus mutans.* Also ,it is been reported that fatty acid in propolis, acted on the virulence factors of dental caries[15]. Literature evidence show varied differences in antibacterial activity by propolis. This was explained due to different composition of propolis because of regional vegetation. However, according to the available data, aloe vera was found to be more efficacious compared to propolis.Although the natural agents namely aloe vera and propolis exert bacteriostatic effect, it does not possess bactericidal effect. And they are reported to be inferior compared to chlorhexidine [16].

The goal of cavity disinfection is to induce "self-repair" to arrest the progression of caries and maintain vitality of pulp. Such an intervention will succeed if the procedure is meticulously performed followed up with the ideal restoration thereafter. Thus it would be fair to suggest that excavation alone will not completely eliminate cariogenic bacteria. Cavity disinfection is mandatory which in turn will prevent secondary caries contributing to longevity of the restoration. Based on the results of the survey, among the disinfectants, chlorhexidine is been the priority and can be considered as the primary choice. Thus the use of disinfecting agents could herald a new beginning in the field of dentistry.

CONCLUSION

The present survey concluded that, though the awareness of cavity disinfection prevail among dentists, its importance needs to be dictated and its use needs to be mandatorily implicated, to contribute to long term restorative success. However, every dentist needs to broaden the understanding that, cavity disinfection step cannot be ignored.

Table I: Represents the frequency distribution of the survey

Variable	Response	N	%
Gender	Female	229	71.8
	Male	90	28.2
	Total	319	100.0
Education	No response	29	9.1
	Postgraduate	178	55.8
	Undergraduate	112	35.1
Practitioner	No response	157	49.2
	BDS Practitioner	82	25.7
	General Dentist	3	.9

	Practitioner with Specialization	46	14.4
	Specialist	31	9.7
Mode of Practice	No response	179	56.1
	Academician only	16	5.0
	Academics and clinical practice	63	19.7
	Practitioner only	61	19.1
Years of experience in practice	No response	88	27.6
	1 to 10 years	122	38.2
	10 to 20 years	9	2.8
	Less than 1 year	100	31.3
Does mechanical debridement using only hand piece eradicate disease causing organisms during cavity preparation	Maybe	54	16.9
	No	231	72.4
	Yes	34	10.7
Are you aware of cavity disinfection procedure following cavity preparation in a caries affected tooth	Maybe	18	5.6
	No	41	12.9
	Yes	260	81.5
Is cavity disinfection procedure necessary prior to restorations	Maybe	57	17.9
	No	4	1.3
	Yes	258	80.9
Do you follow cavity disinfection protocol of prepared cavity prior to restorations in your practice	Maybe	62	19.4
	No	111	34.8
	Yes	146	45.8
Which disinfecting agents is effective in eradicating disease causing organism	Chemical agents	240	75.2
	Do not know	21	6.6
	Lasers	42	13.2
	Natural agents	5	1.6
	Not aware	11	3.4
Which chemical agent is most commonly used for disinfection of prepared cavity	Chlorhexidine	120	37.6
	Do not know	23	7.2
	Ethylenediaminetetraacetic acid	17	5.3
	Not aware	9	2.8
	Saline	19	6.0
	Sodium Hypochlorite	131	41.1
Which natural agents can be used for effective cavity disinfection	Aloe Vera	14	4.4
	Do not know	96	30.1
	Not aware	35	11.0
	Propolis	110	34.5
	Tea tree oil	64	20.1
Which laser systems can be used for effective disinfection of prepared cavity	Diode lasers	101	31.7
	Do not know	80	25.1
	Erbium, chromium-doped yttrium, scandium, gallium and garnet lasers	112	35.1
	Not aware	26	8.2
Is isolation a necessary procedure during cavity disinfection protocol	Maybe	15	4.7
	No	8	2.5
	Yes	296	92.8

Which isolation protocol would you prefer to be followed	Cotton Isolation & Absorber wafers	30	9.4
	Evacuator system & Saliva ejector	36	11.3
	None of the above	1	.3
	Rubber Dam isolation	252	79.0

Table II: Represents the p value amongst the various protocols followed by an individual

Practitioner	**Response**	**BDS Practitioner**		**General Dentist**		**Practitioner with Specialization**		**Specialist**		**p value**
		N	%	N	%	N	%	N	%	
Are you aware of cavity disinfection procedure following cavity preparation in a caries affected tooth	Maybe	5	6.1			3	6.5			0.08
	No	21	25.6	1	33.3	5	10.9	3	9.7	
	Yes	56	68.3	2	66.7	38	82.6	28	90.3	
	Total	82	100.0	3	100.0	46	100.0	31	100.0	
Is cavity disinfection procedure necessary prior to restorations	Maybe	20	24.4	1	33.3	5	10.9	1	3.2	0.20
	No	1	1.2							
	Yes	61	74.4	2	66.7	41	89.1	30	96.8	
	Total	82	100.0	3	100.0	46	100.0	31	100.0	
Do you follow cavity disinfection protocol of prepared cavity prior to restorations in your practice	Maybe	12	14.6			12	26.1	4	12.9	0.35
	No	31	37.8	2	66.7	11	23.9	9	29.0	
	Yes	39	47.6	1	33.3	23	50.0	18	58.1	
	Total	82	100.0	3	100.0	46	100.0	31	100.0	
Which disinfecting agents is effective in eradicating disease-causing organism	Chemical agents	54	65.9	2	66.7	30	65.2	23	74.2	0.001*
	Do not know	7	8.5			7	15.2	4	12.9	
	Lasers	12	14.6			9	19.6			
	Natural agents	3	3.7					1	3.2	
	Not aware	6	7.3	1	33.3			3	9.7	
	Total	82	100.0	3	100.0	46	100.0	31	100.0	
Which chemical agent is most commonly used for disinfection of prepared cavity	Chlorhexidine	30	36.6			21	45.7	16	51.6	0.001*
	Do not know	6	7.3			7	15.2			
	Ethylenediaminetetraacetic acid	4	4.9			2	4.3			
	Not aware	5	6.1	2	66.7			1	3.2	
	Saline	6	7.3			4.3	4.3	1	3.2	
	Sodium Hypochlorite	31	37.8	1	33.3	30.4	30.4	13	41.9	
	Total	82	100.0	3	100.0	100.0	100.0	31	100.0	
Which natural agents can be used for effective cavity disinfection	Aloe Vera	6	7.3			2	4.3	1	3.2	0.001*
	Do not know	29	35.4			16	34.8			
	Not aware	14	17.1	3	100.0			12	38.7	
	Propolis	16	19.5			18	39.1	16	51.6	
	Tea tree oil	17	20.7			10	21.7	2	6.5	
	Total	82	100.0	3	100.0	46	100.0	31	100.0	
Which laser systems	Diode lasers	27	32.9			9	19.6	9	29.0	0.001*

can be used for effective disinfection of prepared cavity	Do not know	25	30.5			15	32.6			
	Erbium, chromium-doped yttrium, scandium, gallium and garnet lasers	17	20.7	2	66.7	22	47.8	15	48.4	
	Not aware	13	15.9	1	33.3			7	22.6	
	Total	82	100.0	3	100.0	46	100.0	31	100.0	
Is isolation a necessary procedure during cavity disinfection protocol	Maybe	8	9.8	1	33.3	2	4.3			0.028*
	No	3	3.7					2	6.5	
	Yes	71	86.6	2	66.7	44	95.7	29	93.5	
	Total	82	100.0	3	100.0	46	100.0			
Which isolation protocol would you prefer to be followed	Cotton Isolation & Absorber wafers	15	18.3			5	10.9	2	6.5	0.013*
	Evacuator system & Saliva ejector	15	18.3			7	15.2	2	6.5	
	None of the above	1	1.2							
	Rubber Dam isolation	51	62.2	3	100.0	34	73.9	27	87.1	
	Total	82	100.0							

*Significant difference ($p<0.05$; chi square test)

Authors' contributions

SK,SM and SN provided the study design. SV,SK, and SN performed experiments. SK and SN analyzed the data, SV prepared the first draft, SK, SM and SN edited and completed the manuscript. All authors read and approved the final version of the manuscript for publication.

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Conflicts of interest

There are no conflicts of interest.

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