International Journal of Dental Sciences and Research, 2015, Vol. 3, No. 3, 72-78
Available online at http://pubs.sciepub.com/ijdsr/3/3/7

DOI:10.12691/ijdsr-3-3-7

Placement of Posterior Composite Restorations in Palestine Dental Practices: Techniques, Problems, and Attitudes

Tarek H. Rabi*

Al-Quds University, Palestine
*Corresponding author: tarekrabi@gmail.com

Received March 09, 2015; Revised April 02, 2015; Accepted May 31, 2015

Abstract The management of posterior teeth damaged due to various factors has undergone considerable improvement over the years. Every year, dental technology and materials are advancing. One such advancement is steady replacement of amalgam with composites. This study was done to evaluate the attitude and techniques employed by general dental practitioners of Palestine during restoration of posterior teeth with composite. A questionnaire to evaluate the attitude of the Palestinian dental practitioners was distributed to 200 dentists in a local dental conference. The questionnaire consisted of general questions such as gender and years of experience as well as specific questions related to posterior composites placement such as techniques used while placement, problems encountered and factors affecting the placement of restoration in posterior teeth. 123 responses were obtained with a response rate of 61.5%. Esthetics seems to be the prime factor affecting the choice of material for posterior teeth restoration followed by patient's preference. As per the study, moisture control is the most affecting factor of the placement of posterior composites and is suggested to be the most common problem encountered during placement of composites in the teeth. Incremental curing is a regularly used practice as per 63.4% participants. Mostly, universal matrix is used for the composite placement. For the wedging between the teeth, wooden wedges were preferred by majority of the general dental practitioners of Palestine. LED is found to be the most commonly used light cure source for the curing of composites. From this study, it can be concluded that more and more general dental practitioners in Palestine are using composites for the restoration of posterior teeth. Still there is a scope of continued improvement in this field.

Keywords: *composites, posterior restorations, esthetic restorations, amalgam safety, posterior composite restoration*

Cite This Article: Tarek H. Rabi, "Placement of Posterior Composite Restorations in Palestine Dental Practices: Techniques, Problems, and Attitudes." *International Journal of Dental Sciences and Research*, vol. 3, no. 3 (2015): 72-78. doi: 10.12691/ijdsr-3-3-7.

1. Introduction

Past surveys have revealed that the choice of material and treatment also depend on certain general perception of the society and fraternity. [1] For this reason, the clinicians must be well aware of all the merits and demerits of using a restorative materials as all the new advances and the patient's demands may not be in best interest of the patient. Thus studies must be done to evaluate the current status of the attitudes of dental practitioners regarding these advances.

As the demand of esthetics is increasing, the use of resin composites over amalgam is on increase among clinicians of various regions. [2] Indeed, resin composite has provided a great alternative to amalgam in posterior teeth restoration. [3] Global concerns regarding mercury in the environment are the primary driver for the discontinuation of dental amalgam [4].

Till 1970s, amalgam and metals such as gold were used for the restoration of damaged posterior teeth. By 1990s, despite of the introduction of the composite materials and bonding agents, their use was limited to the restoration of the teeth with limited occlusal function. During this time, several surveys of dental undergraduate studies revealed that many graduating dentists had limited clinical experience in the placement of posterior composites [5,6,7].

However the situation has evolved over the years due to evolution of newer generations of composites with better qualities and characteristics.

Now posterior teeth composite restoration has been practiced for more than 30 years. [8] The advantage of using composite is not only limited to esthetics but less tooth is sacrificed during cavity preparation for composite restoration. Also restored tooth has increased fracture resistance [9].

In a study, Simecek et al concluded that there was a significantly higher risk of replacement for posterior

composite restorations as compared to amalgam. [8] But because of the awareness and concern about use of mercury has led to the declination in the use of amalgam. [10]

Various benefits of composite restoration include:

1. Healthy tooth tissue s spared.
2. Increased fracture resistance of the restored tooth.
3. Better adhesive properties ensure less microleakage.

Some problems associated with the composites are:

- Shrinkage and post operative sensitivity
- Restoration wear
- Poor contact points
- Composite fracture
- Secondary caries.

In various parts of the world, the use of composites has gained pace as compared to amalgam [11]. However, not many studies have been done to evaluate the current trends in composite restoration in Palestine. Thus, it is appropriate to evaluate the attitude of Palestinian dentists regarding posterior composite placement. This study was aimed to evaluate what the dental general practitioners think about using composite in posterior teeth.

2. Materials and Methods

A questionnaire regarding use of composites in the posterior teeth was distributed among 200 Palestinian dentists in a local dental conference. The questionnaire was inspired from article on posterior composite restoration in United Kingdom dental practices. An approval was taken from Dr. Lynch about this. The questionnaire included both open and closed questions:

1. General questions such as gender and years of experience in dental field.
2. Factors influencing choice to place a posterior composite.
3. Perceptions about composite
4. Factors causing problems in placement of composites in posterior teeth.
5. Choice of material in shallow cavities
6. Choice of material in moderate cavities
7. Choice of material in deep cavities.
8. Use of rubber dam and incremental curing
9. The matrix used during use of posterior composite
10. The wedge, light cure, bonding agent used.
11. Commonly encountered post treatment problems.

Data was collected anonymously. Descriptive results are reported.

3. Results

123 responses were obtained out of 200 Palestinian dental practitioners with a response rate of 61.5%. The results obtained are as follows:

3.1. General information

Out of 123 respondents, 60.2% are male while 39.8% are female practitioners. Out of these participants, 65.9% practitioners are having an experience of 0-5Years while 15.5% are having an experience of over 15 years. The respondents with experience 5-9 years and 10-15 years were 10.6% and 8.1% respectively. (Table 1)

Table 1. general information

		0-5 Years		5-9 Years		10-15 years		More than 15		
		Count	%	Count	%	Count	%	Count	%	
Gender	Female	34	41.9%	7	53.9%	1	10.0%	7	36.8%	
	Male	47	58.0%	6	46.2%	9	90.0%	12	63.2%	
		81	65.9%	13	10.6%	10	8.1%	19	15.5%	123

3.2. Factors Influencing the Choice of Material to Place a Posterior Restoration

The choice of composite to avoid destruction of the sound tooth is agreed by 30.1% respondent GDPs. As per 77.2% participants patient's esthetic demand is the chief factor influencing the choice of composite for posterior teeth restoration. Other common factors affecting the choice of composites are clinical situation (56.9%) and patient's choice (48.8%). Least influencing factors include cracked tooth (8.1%) and concerns about amalgam safety (8.9%). Detailed results are given in Table 2.

Table 2. Factors influencing choice of the material for posterior restoration

		0-5 Years		5-9 Years		10-15 years		More than 15	
		Count	%	Count	%	Count	%	Count	%
Factors influencing your choice to place a posterior composite	Avoid destruction of sound tooth	24	29.6%	4	30.8%	4	40.0%	5	26.3%
	Patients concern amalgam safety	5	6.2%	1	7.7%	2	20.0%	3	15.8%
	Confidence with using restorative material	14	17.3%	8	61.5%	9	90.0%	8	42.1%
	Journal articles	12	14.8%	0	0.0%	3	30.0%	5	26.3%
	Clinical Situation	48	59.3%	9	69.2%	8	80.0%	6	31.6%
	Patients esthetic demands	64	79.0%	13	100.0%	10	100.0%	8	42.1%
	Patients financial situation	26	32.1%	1	7.7%	0	0.0%	2	10.5%
	Patients wish for a certain material	43	53.1%	7	53.9%	7	70.0%	3	15.8%
	Cracked tooth	10	12.4%	0	0.0%	0	0.0%	0	0.0%
	Dentists concern regarding amalgam safety	11	13.6%	0	0.0%	0	0.0%	8	42.1%

3.3. Dentist's Perception about Posterior Composite

Participants were asked about their perceptions about posterior composites. (Table 3) Majority of the participants said that composites are more aesthetic (78.9%) and less destructible (78.9%). 31.6% GDPs said that composites are technically demanding. The degree of agreement and disagreement about various factors is illustrated in Figure 1.

Table 3. dentist perception about composites

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
Your perception of posterior composite	Less destructive	36	44.4%	7	53.9%	5	50.0%	15	78.9%
	Technically demanding	27	33.3%	5	38.5%	4	40.0%	6	31.6%
	Superior qualities	18	22.2%	2	15.4%	1	10.0%	15	78.9%
	More costly to the patient	15	18.5%	4	30.8%	5	50.0%	3	15.8%
	Time consuming	30	37.0%	8	61.5%	4	40.0%	3	15.8%
	More esthetic	63	77.8%	10	76.9%	8	80.0%	15	78.9%
	Patient preference	21	25.9%	7	53.9%	1	10.0%	1	5.3%

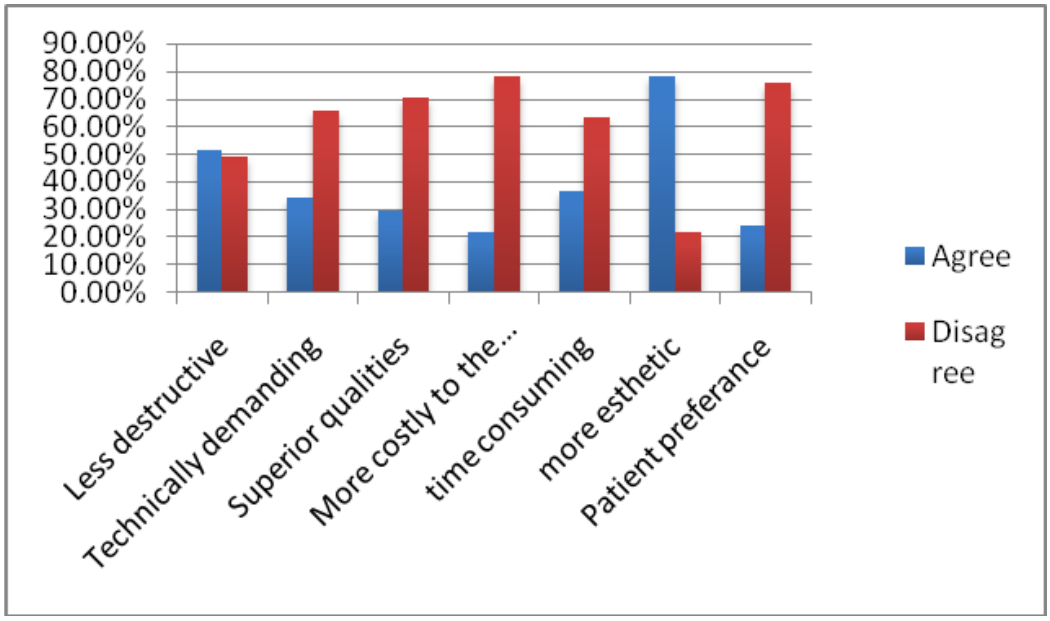

Figure 1. Degree of agreement on various perceptions about composites

Respondents were asked about the difficulties faced during placement of posterior composites. (Table 4, Figure 2) Moisture control seems to be one of the most common faced difficulty (84.2%) followed by maintaining contacts (68.4%) and contact point contour (63.2%).

Table 4. Difficulties faced during placement of posterior composites

		0-5 Years		5-9 Years		10-15 years		More than 15	
		Count	%	Count	%	Count	%	Count	%
Factors causing difficulty during the placement of posterior composites	Contact point contour	36	44.4%	10	76.9%	10	100.0%	12	63.2%
	Lack of consensus	9	11.1%	5	38.5%	4	40.0%	3	15.8%
	Avoiding overhangs	25	30.9%	8	61.5%	7	70.0%	1	5.3%
	Maintaining contacts	38	46.9%	11	84.6%	12	120.0%	13	68.4%
	Finishing	12	14.8%	2	15.4%	1	10.0%	0	0.0%
	Moisture control	60	74.1%	13	100.0%	10	100.0%	16	84.2%
	Incremental curing	15	18.5%	5	38.5%	1	10.0%	0	0.0%
	Cavity design	6	7.4%	0	0.0%	0	0.0%	0	0.0%
	Material is difficult to manipulate	15	18.52%	0	0.0%	0	0.0%	3	15.8%
	Restorations are difficult to monitor	9	11.11%	0	0.0%	0	0.0%	0	0.0%
	Wide range of products	12	14.81%	3	23.1%	3	30.0%	0	0.0%

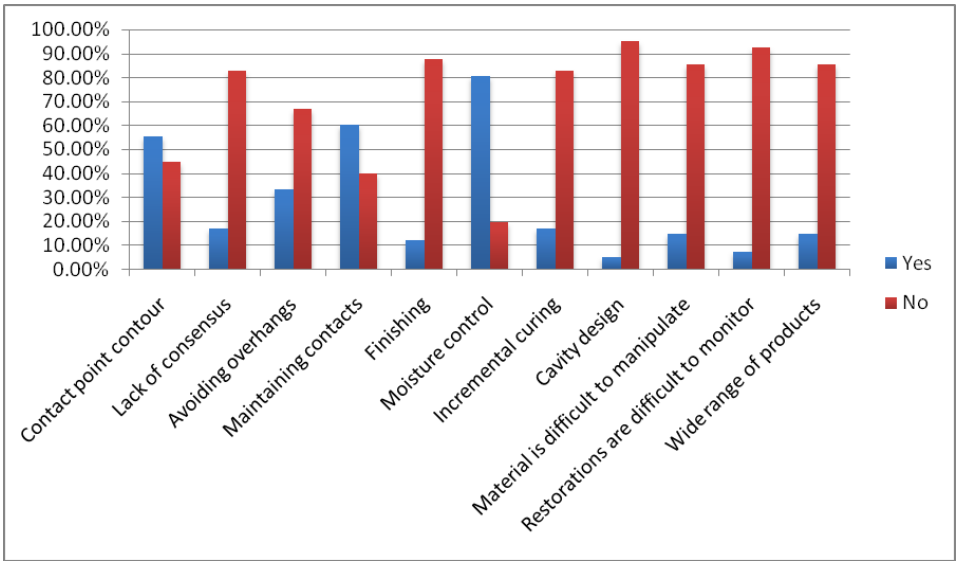

Figure 2. problems encountered during composite placement

3.4. Techniques Used During Placement of Posterior Composite Restoration

On asking about the operatively exposed dentin in case of shallow, medium and deep cavities, following data was collected. (Table 5, Table 6, Table 7) As per the results, majority participants said that there is no need of any base or liner in shallow cavities (n=101) and moderate cavities (n=65) while calcium hydroxide liner and glass ionomer base is needed in deep cavities (n=83).

Table 5. Management of operatively exposed dentin in shallow cavities

	Materials used	0-5 Years		5-9 Years		10-15 years		more than 15	
In management of operatively exposed dentin in SHALLOW cavities you would use		Count	%	Count	%	Count	%	Count	%
	Calcium hydroxide (liner) &Glass ionomer cement (base)	5	6.2%	0	0.0%	0	0.0%	0	0.0%
	Glass ionomer cement (base)	10	12.4%	1	7.7%	1	10.0%	5	26.3%
	No base/liner	66	81.5%	12	92.3%	9	90.0%	14	73.7%
		81	65.9%	13	10.6%	10	8.1%	19	15.4%

Table 6. Management of operatively exposed dentin in moderate cavities

	Materials used	0-5years		5-9years		10-15years		More than 15	
		Count	%	Count	%	Count	%	Count	%
In management of operatively exposed dentin in MODERATE cavities you would use	Calcium hydroxide (liner) & Glass ionomer cement (base)	15	18.5%	0	0.0%	0	0.0%	0	0.0%
	Glass ionomer cement (base) only	37	45.7%	4	30.7%	1	10.0%	1	5.3%
	No base/liner	29	35.8%	9	69.2%	9	90.0%	18	94.7%
		81	65.9%	13	10.6%	10	8.1%	19	15.4%

Table 7. Management of operatively exposed dentin in deep cavities

In management of operatively exposed dentin in DEEP cavities you would use	Calcium hydroxide (liner) & Glass ionomer cement (base)	62	76.5%	9	69.2%	8	80.0%	4	21.1%
	Glass ionomer cement (base) only	9	11.1%	1	7.7%	2	20.0%	12	63.2%
	No base/liner	10	12.4%	3	23.1%	0	0.0%	3	15.8%
		81	65.9%	13	10.6%	10	8.1%	19	15.4%

3.5. Use of Rubber Dam while Placing the Composites

As per the study, majority of the dentists have never used rubber dam while posterior composite placement (n= 66) while only a small percentage of respondents have used rubber dam always. (n=12)

Table 8. Use of rubber dam

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
In placement of posterior composite you use the rubber dam	Always	10	12.4%	0	0.0%	1	10.0%	1	5.3%
	Mostly	2	2.5%	0	0.0%	0	0.0%	0	0.0%
	Never	40	49.4%	10	76.9%	3	30.0%	13	68.4%
	Occasionally	9	11.1%	2	15.4%	4	40.0%	3	15.8%
	Rarely	20	24.7%	1	7.7%	2	20.0%	2	10.5%
		81	65.9%	13	10.6%	10	8.1%	19	15.4%

3.6. Use of Incremental Curing

Placement of posterior composites is almost always done with incremental curing as per 63.4% participants. As per 17.1% participants, incremental curing is used either mostly or rarely (Table 9).

3.7. Matrix and Wedges Used

Universal matrix is used for posterior composite placement as per the majority of the respondents (n=80) while "automatrix" was matrix of choice as per 5.7% participants. (Table 10). When asked about the wedges, majority of participants use wooden wedges (n=89). (Table 11).

3.8. Light Cure and Bonding Agent Used

Majority of the respondents chose LED for their light cure unit (n=98). (Table 12) As per the study, 70/123 respondents chose 5th generation bonding agents while placing the posterior composites (Table 13).

Table 9. Use of incremental curing

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
In placement of posterior composite you use incremental curing	Always	51	62.9%	7	53.9%	4	40.0%	16	84.2%
	Mostly	15	18.5%	4	30.8%	2	20.0%	0	0.0%
	Occasionaly	3	3.7%	0	0.0%	0	0.0%	0	0.0%
	Rarely	12	14.8%	2	15.4%	4	40.0%	3	15.8%
		81	65.9%	13	10.6%	10	8.1%	19	15.4%

Table 10. Matrix used for posterior composites placement

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
The matrix you use for posterior composite	Automatrix	6	7.4%	0	0.0%	0	0.0%	1	5.3%
	Sectional	9	11.1%	1	7.7%	0	0.0%	1	5.3%
	transparent matrix	18	22.2%	3	23.1%	2	20.0%	2	10.5%
	Universal	48	59.0%	9	69.2%	8	80.0%	15	78.9%
		81	65.9%	13	10.6%	10	8.9%	19	14.6%

Table 11. Wedges used during posterior composite restoration

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
The wedge you use	I do not use a wedge with matrix	6	7.4%	2	15.4%	0	0.0%	5	26.3%
	Plastic	12	14.8%	1	7.7%	0	0.0%	3	15.8%
	Transparent	3	3.7%	0	0.0%	0	0.0%	2	10.5%
	Wood	60	74.1%	10	76.9%	10	100.0%	9	47.4%
		81	65.9%	13	10.6%	10	8.9%	18	14.6%

Table 12. Light cure unit used

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
The light cure you use	Halogen	9	11.1%	3	23.1%	0	0.0%	11	57.9%
	LED	71	87.7%	10	76.9%	10	100.0%	7	36.8%
	Other	1	1.2%	0	0.0%	0	0.0%	1	5.3%
		81		13		10		19	

Table 13. Bonding agents used

		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
The bonding agent you use	4th generation (primer alone, adhesive alone)	22	27.2%	2	15.4%	0	0.0%	0	0.0%
	5th generation(primer + adhesive)	42	51.9%	5	38.5%	7	70.0%	16	84.2%
	6th generation	0	0.0%	1	7.7%	0	0.0%	0	0.0%
	7th generation (all in one)	17	20.9%	5	38.5%	3	30.0%	3	15.8%
		81		10		10		19	

3.9. Commonly Encountered Post-treatment Problems

Food packing is rarely encountered problem as per 78/123 participants. As per 81/123 respondents staining is rarely encountered problem. Regarding loss of retention, majority of the dental practitioners said that they never/rarely encountered this problem (n= 54). Majority of participants said that tooth fracture is encountered rarely (n=69). Post-treatment problems subsequent to root canal treatment are encountered rarely as per majority of dentists (n=77).

Table 14. commonly encountered post-treatment problems

		0-5 Years		5-9 Years		10-15 years		more than 15	
Commonly encountered post-treatment problems Food packing		Count	%	Count	%	Count	%	Count	%
	Never	21	25.9%	1	7.7%	5	50.0%	3	15.8%
	Often	12	14.8%	1	7.7%	2	20.0%	0	0.0%
	Rarely	48	59.3%	11	84.6%	3	30.0%	16	84.2%
		81							
		0-5 Years		5-9 Years		10-15 years		more than 15	
Commonly encountered post-treatment problems staininng		Count	%	Count	%	Count	%	Count	%
	Never	9	11.1%	0	0.0%	0	0.0%	2	15.8%
	Often	27	33.3%	0	0.0%	1	9.1%	3	15.8%
	Rarely	45	55.6%	13	100.0%	10	90.9%	13	68.4%
	Always	0		0		0		0	
		81							
		0-5 Years		5-9 Years		10-15 years		more than 15	
		Count	%	Count	%	Count	%	Count	%
Commonly encountered post-treatment problems loss of retention	Always	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Never	33	40.7%	4	30.8%	4	40.0%	13	68.4%
	Often	9	11.1%	2	15.4%	4	40.0%	0	0.0%
	Rarely	39	48.2%	7	53.9%	2	20.0%	6	31.6%
		81							

4. Discussion

In this study, the pattern seen for the use of posterior composites is found to follow the universal pattern (Figure 1). As per the participants, esthetics and patient's selection played a major role in opting composites for posterior restoration. In a similar study conducted in Saudi Arabia, 90% participants carry posterior composite restoration in patients because of esthetic demands. [12] This figure reaches upto 96% in the similar study conducted in UK.[13] Also, majority of the practitioners disagreed on the fact that the composite restoration is technically demanding (65.9%) or time consuming (63.4%). In similar study conducted in UK, these figures are 74% and 79% respectively [13]. Though the qualities of the composites are still being the top most reason that dental practitioners (70.7%) are going for its conventional alternatives. As per the study, moisture control is still an issue with posterior composite placement. In similar study in nothern Saudi Arabia, isolation is an issue with posterior composite restoration as per 36% of the participants. [12] The composites are hydrophobic in nature thus placement of composites becomes difficult if the moisture control is not adequate. [14] For this rubber dam provides a solution. As per this study, rubber dam is never used by majority of the practitioners (53.7%). This figure is fairly higher (>80%) as per the study conducted by Gilmour et al in UK. [13] There are also several evidences suggesting that rubber dam is not necessary in posterior composite restoration [15].

Regarding the management of operatively exposed dentin in shallow and deep cavities, the dental practitioners are opting for various techniques such as liners and bases. (Table 5, Table 6, Table 7). In the study conducted by Gilmour et al 63% of participants preferred calcium hydroxide in deep cavities which is higher than the observed statistics in this study. [13] Liners have also been advocated in several researches. [16] The placement of liners and bases may result in diminshed thickness of the restoration resulting in decreased compressive strength. The use of liners and bases for posterior composites is just following the same trend of using bases beneath amalgam restoration [12].

As per this study, majority of the practitioners are opting for LED light cure units (79.7%) whereas in the study conducted in united kingdom, almost every participant is using either halogen LCUs or LEDs. LED lamps have been found to be quite effective during composite placement. [17] In this study it was found that majority of the dental practitioners are still using fifth generation bonding agents (56.9%) while few have moved up to 6^{th} and 7^{th} generations. Recent researches have also

suggested that the results provided by these bonding agents are comparable. [18] Fifth generation bonding agents are preferred as it provides primer and adhesive in one bottle and makes the procedure of bonding hassle free. Some investigators have found the values similar to the previous three step bonding while other shows relatively lower values of bond strength, [19] though much of the variations are accredated to technique used.

Regarding the commonly encountered post treatment problems, food packing, staining, loss of retention and tooth fracture were taken into account. Majority of the participant suggested that they have never or rarely encountered these problems during their practice. (Table 14) On the contrary, in the study conducted in northern Saudi Arabia, restoration fracture is quite common problem encountered as per 83.8% participants. [12] Also as per the study conducted in UK, similar results were found where majority of the participants said that they have rarely encountered these problems. [13] In one-year clinical evaluation by Yip et al., all the direct posterior composite restorations were also rated as excellent for surface-staining criteria. [20] Loguercio et al. and Dresch et al. stated that 100% Alpha ratings were obtained for the retention criteria in a 12-month evaluation of different composite restorations. [21,22] Thus the improved resin composites that are being used in the dental practices are having better properties making them a perfect fit for the posterior teeth restoration.

5. Conclusion

From the above study it is clear that there is a scenario of confusion while using composites in the posterior teeth restoration, especially in the field of operatively exposed dentin in different depth cavities. In this study it was cited that moisture control and rubber dam placement are essential for posterior composite restoration. Also the post treatment problems are not a major issue if the composites are placed in the posterior teeth using right technique. From the above results it can be concluded that, despite of the availability of limited information, Palestinian dental practitioners are encouraging composite restoration in posterior teeth with the best methods available and that too with a high success rate. To avoid the ongoing confusions in composites field, more of the studies should be done in this domain.

References

[1] Deligeorgi V, Mjor IA, Wilson NH. An overview of reasons for the placement and replacement of restorations. *Prim Dent Care*.8(1): 5-11.2008.

[2] Palmer C. “Good progress reported in mercury treaty talks”. *ADA News*. 42(21). 1-2. 2011.

[3] Simecek JW, Diefenderfer KE, Cohen ME. “An evaluation of replacement rates for posterior resin-based composite and amalgam restorations in US. Navy and marine corps recruits.” *J Am Dent Assoc*. 140(2). 200-209. 2009.

[4] Bohaty B S. Ye Q. Misra A. Sene F. Spencer P. “Posterior composite restoration update: focus on factors influencing form and function”.*Clin Cosmet Investig Dent*. 5.33-42. 2013. Published online 2013 May 15.

[5] Wilson NHF, Setcos JC. “The teaching of posterior composites: a worldwide survey.” *J Dent* 17: 29-33. 1989.

[6] Wilson NHF, Mjör I. “The teaching of Class I and Class II direct composite resin restorations in European dental schools.” *J Dent* 28: 15-21. 2000.

[7] Mjör I, Wilson NHF. Teaching of Class I and Class II direct composite resin restorations: results of a survey of dental schools. *JADA* 129: 1415-1419. 1998.

[8] Simecek JW, Diefenderfer KE, Cohen ME. An evaluation of replacement rates for posterior resin-based composite and amalgam restorations in US. Navy and marine corps recruits. J Am Dent Assoc. 2009;140(2):200-209.

[9] Bohaty B S, Ye Q. Misra A. Sene F. Spencer P. “Posterior composite restoration update: focus on factors influencing form and function.” *Clin Cosmet Investig Dent.* 5. 33-42. 2013..

[10] Phillips, R.W.Avery, D.R.Mehra, R. et al. “Observations on a composite resin for class II restorations: three-year report”. *J Prosthet Dent*. 30.891-897. 1973.

[11] Brown LJ, Wall T, Wassenaar JD. Trends in resin and amalgam usage as recorded on insurance claims submitted by dentists from the early 1990s and 1998 (abstract 2542). *J Dent Res* 2000 79: 461.

[12] Akbar I. “Knowledge and Attitudes of General Dental Practitioners Towards Posterior Composite Restorations in Northern Saudi Arabia”. *JCDR*. 9(2):61-64. 2015.

[13] Lynch C., Gilmour A, Latif M, Addy L. “Placement of posterior composite in united kingdom dental practices”. *International dental journal* 59: 148-154. 2009.

[14] Stephen J. Bonsor, Gavin Pearson. *A Clinical Guide to Applied Dental Materials.* Churchill Livingstone Elsevier publication, China, 2013. 92-93.

[15] Brunthaler A, Konig F, Lucas T *et al*. “Longevity of direct resin composite restorations in posterior teeth”. *Clin Oral Invest* 7. 63-70. 2003.

[16] Council on Scientific Affairs of the American Dental Association.4(2). Spring 2009.

[17] Keogh P, Ray NJ, Lynch CD *et al*. “Surface micro-hardness of a resin composite exposed to a ‘first-generation’ LED curing lamp, *in vitro”*. *Euro J Prosthodont Rest Dent.* 12. 177-180. 2004.

[18] Peumans M, Kanumilli P, De Munck J *et al*. “Clinical effectiveness of contemporary adhesives: a systematic review of current clinical trials”. *Dent Materials.* 21. 864-881. 2005.

[19] Swift EJ Jr, BayneSC. “Shear bond strength of a new"one- bottle" dentin adhesive”. *AmJ Dent* 10.184-88. 1997.

[20] Yip KH, Poon BK, Chu FC, Poon EC, Kong FY, Smales RJ. “Clinical evaluation of packable and conventional hybrid resin-based composites for posterior restorations in permanent teeth: Results at 12 months”. *J Am Dent Assoc*. 134. 1581-9. 2003.

[21] Loguercio AD, Reis A, Rodrigues Filho LE, Busato AL. “One-year clinical evaluation of posterior packable resin composite restorations”. *Oper Dent.* 26.427-34. 2001.

[22] Dresch W, Volpato S, Gomes JC, Ribeiro NR, Reis A, Loguercio AD. “Clinical evaluation of a nanofilled composite in posterior teeth: 12-month results”. *Oper Dent*. 31.409-17. 2006.