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Knowledge, Attitude, and Practice of Resin Composite Repair among Libyan Practitioners.

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الملخص:

الهدف من الدراسة: لدراسة مدي المعرفة والسلوك والممارسة المعاصرة لإجراءات إعادة ترميم الحشوات الراتنجية بين أطباء الأسنان في بنغازي-ـ ليبيا.

طريقة الدراسة: تم تصميم استبيان مسح مكون من عشرين سؤالاً وتوزيعه على 270 طبيب أسنان متخرج في بنغازي ـــ ليبيا. هدفت الأسئلة للحصول على معلومات فيما يتعلق بالمعرفة والسلوك والتطبيق لإجراءات إعادة ترميم الحشوات الراتنجية المعيبة.

النتائج: بلغ معدل الاستجابة للمسح 94% أظهرت النتائج ان 143 (56.3%) من المشاركين تلقوا تعليمهم حول اعادة ترميم الحشوات الراتنجية أثناء الدراسة الجامعية أو الدراسات العليا أو من مصادر أخري. أشار المشاركون الي أن

أكثر الأسباب شيوعاً لإصلاح الحشوات كانت التسوس الثانوي (24.8%) يليه كسر الحشوة (18.5%)، الفقد الجزئي للحشوة (18.1%)، تغير اللون (17.3 %) الحواف المعيبة ومحيط الحشوة المعيب (9.1 %). علاوة على ذلك أجري (71%) من الأطباء المشاركين إعادة ترميم في عيادات الأسنان. اظهرت الدراسة أن غالبية أطباء الأسنان (72%) يعتبر الحشو الراتنجي حشوة دائمة. ويعتقد أغلبهم (43.3% موافقون بشدة، 43.7% موافقون) في بنغازي أن تدريس تقنية إعادة الترميم يجب أن يُدرج في المناهج الأكاديمية.

الخلاصة: يعتبر إعادة ترميم الحشوات الراتنجية إجراء راسخاً بين أطباء الأسنان الليبيين في بنغازي، والذي يُعتبر بديلاً مشروعاً لاستبدال الحشو الكامل.

الكلمات المفتاحية:

الحشوات الراتنجية، ترميم، الحد الأدنى من التدخل، ممارسين المهنة.

Abstract

Aim: To examine the contemporary knowledge, attitude and practice of resin composite repair procedures among dental clinicians in Benghazi – Libya.

Methods: A survey questionnaire, which consisted of twenty questions, was designed and distributed electronically to 270 graduated dentists in Benghazi - Libya. The questions sought information in relation to the knowledge, attitude and practice of the repair procedures for defective resin composite restorations.

Results: The survey response rate was 94%. The findings of the study showed that 143 (56.3%) of the participants were taught about resin composite repair during undergraduate, postgraduate studies, or from other sources. The respondents indicated that the most common indication for composite repair was secondary caries (24.8%) followed by fracture of restoration (18.5%), partial loss of restoration (18.1%), discoloration (17.3%), defective margin, and defective contour (9.1%). Moreover 71% of the participants performed composite repair in dental clinics. The study results revealed that the majority of the dentists (72%) considered the repaired composite restoration as a permanent filling. Most of the participants (43.3% strongly agreed, 43.7% agreed) in Benghazi believed teaching of composite repair technique should be included in the academic curriculum. In conclusion, resin composite repair is a well-established procedure among Libyan practitioners in Benghazi, which is considered a legitimate alternative to total restoration replacement.

Keywords: Resin Composite; Repair; Minimal Invasive; Practitioners.

1. INTRODUCTION

In the last several years, the use of resin-based composite restorations (RBC) in dental clinics has increased dramatically.[1-4] This is attributed to excellent esthetics, reinforcement of tooth structure, improved mechanical properties,[5]and improved longevity of resin composite restorations.[3,6] Surprisingly, a practice based study has shown that RBC restorations may exhibit longer survival rates than amalgam restorations.[7] Yet, all restorations, including resin composite materials, will experience degradation over time. Materials in the existing restorations as well as tooth-specific factors can effect the clinician's decision to replace or repair the defective restorations.[8] Repair of a restoration is a partial replacement of a failed restoration while preserving the portions of the restoration that exhibit no radiological or clinical signs of failure. On the other hand, replacement of a restoration is the total removal of failed restoration followed by the insertion of a new one.[9]

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Due to an emphasis on minimally invasive dentistry coupled with adhesive technology, composite repair as a treatment option is considered acceptable among dental clinicians. Composite repair is indicated when the defective part of a restoration can be replaced while the intact part is preserved.[10] The defect might be caused by a deficient or discolored margin,[11] fracture, secondary caries, or wear of the restoration.[9]

Some surface treatment techniques used for repairing RBCs have been introduced. The prepared restoration and adjacent tooth surfaces require special chemical or mechanical treatment. Chemical treatment involves treating the substrate with adhesive systems, while mechanical treatment can be achieved by grinding, air-borne particle abrasion or sandblasting.[12-14]

Though the replacement of a restoration is commonly preferred by many clinicians,[15] repairing it might offer numerous advantages. Repairing a defective tooth restoration aids in the elimination of excessive tooth structure loss, minimizes the damage to pulp tissue, reduces procedure time and cost as well as prolongs the function of the tooth.[9,16,17] Those clinical advantages support the significance of the repair procedure for minor restoration defects rather than total replacement.

Hence the aim of this study was to examine the contemporary knowledge, attitude and practice of resin composite repair procedures among dental clinicians in Benghazi - Libya.

2. METHODS

A survey questionnaire, which consisted of twenty questions, was designed and distributed electronically to 270 practicing dentists in Benghazi - Libya. Participants were informed that their demographic data would be kept confidential. The survey questions were tested for content validity and reliability through a pilot study conducted before questionnaire distribution was performed. The questions sought information concerning the knowledge, attitude and practice of repair procedures of defective resin composite restorations. The completed questionnaires were collected and analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive analysis was used to analyze each variable and associations were explored with Chi-square testing and a statistical significance set at a 95% level.

3. RESULTS

The survey response rate was 94%. Responses were collected over a three month period.

145 (57.1%) of the respondents were females and 109 (42.9%) were males. In regards to clinical experience, 100 out of the 254 (39.4%) of participants had 1- 4 years of clinical experience, 71 (28.0%) had 5-9 years of clinical experience and 83 (32.7%) of participants had more than 10 years of experience. 60 out of 254 (23.6%) participants were specialists, while 194 (76.4%) were general dental practitioners. Table 1 illustrates the demographic data of the respondents while Table 2 shows the specialties of the participants.

Table 1. The Demographic data of the participants

	Gender		Age (Years)			Years of Practicing Dentistry			Practice Type		Total
	Female	Male	25-34	35-44	44 and above	1-4	5-9	10 and above	General Dental Practitioner	Specialist	
N	145	109	177	68	9	100	71	83	194	60	254
Percent	57.1	42.9	69.7	26.8	3.5	39.4	28	32.7	76.4	23.6	100

Table 2. Area of practice of the participant specialists

specialty	N	Percent (%)
Endodontic	8	13.3
Operative or Restorative Dentistry	9	15.0
Oral Pathology or Oral Medicine	6	10.0
Oral Surgery	3	5.0
Orthodontics	2	3.3
Paedodontics	4	6.7
Periodontics	5	8.3
Preventive Dentistry	1	1.7
Prosthodontics	22	36.7
Total	60	100.0

The majority of dentists (58.7%) identified the meaning of composite restoration repair to be “removal of just the defective part of the restoration then new composite is applied.”(Table 3)

Table 3. The response of the participants to the meaning of composite repair

Options	N	Percent (%)
Removal of just the defective part of the restoration then new composite is applied.	149	58.7
Removing the whole restoration and replaced with amalgam.	6	2.4
Removing the whole restoration and replaced with new composite restoration.	96	37.8
I do not know.	3	1.2
Total	254	100 %

There was no statistically significant difference (p=0.256) in response rate of the general dental practitioners and specialists to the definition of composite repair procedure. (Table 4)

Table 4. The comparison between the responses of the general dental practitioners and specialists to the meaning of composite restoration repair.

Options	General Dental Practitioners		Specialists	
Removal of just the defective part of the restoration then new composite is applied.	N 109	Percent (%) 56.2	N 40	Percent (%) 66.7
Removing the whole restoration and replaced with amalgam.	6	3.1	0.0	0.0
Removing the whole restoration and replaced with new composite restoration.	76	39.2	20	33.3
I do not know.	3	1.5	0.0	0.0
Total	194	100	60	100

The study showed that 143 (56.3%) of the participants were taught about resin composite repair during undergraduate, postgraduate studies, or from other sources, while 40 (15.7%) of the participants reported that they were not taught about composite repair and 71 (28%) could not recall. A large number of dentists (71%) performed repair of resin composite restorations in their clinics. The respondents thought that the most common indication for composite repair was secondary caries (24.8%) followed by fracture of the restoration (18.5%), partial loss of a restoration (18.1%), discoloration (17.3%), defective margin, and defective contour (9.1%). Sixty eight percent of the dentists preferred repair rather than replacement when treating a small defect in a composite restoration. In the clinical scenario of extensive secondary caries undermining the whole restoration, 96.9% of the dentists choose total replacement of the restoration. (Table 5)

Table 5. The respondents' treatment options for specific clinical scenarios of a defective composite restoration

Treatment options for specific clinical scenarios	Repair of the exiting restoration N (%)	Total replacement of the restoration N (%)	I don't know N (%)
If there is a small defective composite restoration for example (small chipped restoration, marginal staining), the preferred treatment option would be:	175 (68.9%)	75(29.5%)	4(1.6%)
If there is an extensive secondary caries undermining the whole restoration, the preferred treatment option would be:	6(2.4%)	246(96.9%)	2 (0.8%)

Most of the dentists (72%) considered the repaired composite restoration as a permanent filling, while 16.9% considered it as an intermediate filling, 3.9% considered the repaired restoration as a temporary filling and 7.1 % do not know the answer.Table 6 shows that 43.3% of the dentists used phosphoric acid as a surface treatment for composite repair procedures whereas 42.1% applied roughening with diamond bur as a surface treatment. In regard to the type of composite materials used for the repair, 45.3% of the participants used conventional and flowable composite followed by 37% who used conventional composite and 17.7% who chose flowable composite for composite repair.

Table 7 shows the responses of the participants to the questions related to the attitude of the Libyan clinicians toward resin composite repair.

Table 6. The responses of the participants to the questions related to practice of resin composite repair

Types of surface treatment	N	Percent (%)
37% Phosphoric acid etchant	**110**	**43.3**
Air abrasion with Al2O2	**10**	**3.9**
No surface treatment	**20**	**7.9**
Roughening with diamond bur	**107**	**42.1**
Sand blasting	**7**	**2.8**
Total	**254**	**100.0**

Table 7. The responses of the participants related to attitude toward the composite restoration repair.

Questions	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)
Composite restoration repair costs less than total restoration replacement	5 (2%)	43 (16.9%)	6 (24.4%)	111(43.7%)	33(13%)
Composite restoration repair is considered a conservative procedure that save the natural tooth structure when compared to total restoration replacement	2 (0.8%)	29(11.4%)	22(8.7%)	133(52.4)	68(26.8%)
Composite restoration repair is less time consuming when compared to total restoration replacement	4 (1.6%)	28(11%)	45(17.7)	119(46.9)	58(22.8%)
Composite restoration repair is considered a treatment option when the total restoration replacement would increase the risk of pulp damage	5(2%)	36(14.2%)	28(11%)	120(47.2%)	65(25.6%)
Involving the patient in decision making regarding repair or total replacement of the composite restoration is considered a good practice.	16(6.3%)	47(18.5%)	50(19.7%)	105(41.3%)	36(14.2%)
Teaching of composite restoration repair should be included in the academic curriculum	1(0.4%)	6(2.4%)	26(10.2%)	111(43.7%)	110(43.3%)
Total	254 (100%)				

4. DISCUSSION

Resin based composite material was the main choice of several clinicians to repair or replace failed restorations.[4,18-20] Due to the bonding property of the resin composite materials, they can be applied in small areas; hence, they provide an option of repair treatment for defective restorations.[8] The bond strength of the repaired restorations was rated as acceptable by some studies.[19,21] Moreover, the long term-success of restorations repaired with resin composite materials was evaluated clinically and found to be acceptable.[11,22,23]

The present study is a cross sectional survey that had a 94% response rate. The questions were divided into four main parts: demographic data, knowledge of the participants, attitude of the responders to the composite repair, and practice of composite repair among the dentists. As the study was a questionnaire survey, risk may exist in the reliability of the responses and the possibility of nonresponse bias. The adopted survey questions were selected in order to enhance comparison with previous studies. Composite repair as a treatment option was considered acceptable among Libyan clinicians as per the response gained. The finding of our study revealed that 71% of the participants performed composite repair. However, when we inquired about the meaning of the composite repair, only 58.7% of the respondents selected the correct answer. This lack of clarity on the definition may mean that fewer than 71% are actually performing composite repair.

The specialists in operative or restorative dentistry were just 15% of the study participants; as a result, the advanced training in restorative or operative dentistry affected the decision-making choices of the clinician for treating defective composite restorations. However, the majority of respondents (69.9%) selected to repair rather than replace a small defective restoration. While in the clinical scenario of extensive secondary caries undermining the whole restoration, 96.9% of the dentists choose total replacement of the restoration. Twenty four percent of the participants advocated that secondary caries was the most common repair indication. Gordan et al., likewise reported that secondary caries was the main reason for repair (43%).[24]

The choice for repair or replace RBCs depends on the size and site of the defect. In general localized and accessible defects are advised for repair rather than total restoration replacement. While in clinical scenarios where the failed part of the restoration is inaccessible clinically or is a large defect, the restoration replacement is considered the preferred decision.[17] Besides, replacing the whole restoration does not guarantee that the new restoration will exceed the clinical behavior of the repaired ones.[23,25] Surprisingly, a 10 year clinical trial reported that the clinical performance of the repaired restorations is similar to the completely replaced restorations.[16]

However, Sheiham mentioned that multiple restoration repairs cause more tooth structure loss and decease in the life expectancy of the repaired restoration. [26]

Muhammad Fareed et al mentioned that performing a repair on an old composite restoration leads to tooth structure preservation and reduction in the procedure time.[27] This is in agreement with our study in which 52.4% and 26.8% of the participants replied as agreed or strongly agreed, respectively, regarding repair being a less invasive procedure when compared to total restoration replacement. Moreover 46.9% and 22.8% of the participants agreed and strongly agreed, respectively, that composite repair is

a less time consuming procedure than whole restoration replacement. Furthermore, Ferna´ndez et al., mentioned that repairing resin restorations with defects in the proximal or occlusal anatomy would improve the prognosis and reduce the problems associated with insufficient contact.[16]

Blum reported that repair rather than total replacement is the more cost effective procedure.[9] This is in accordance with our data in which 43.7% and 13% agreed and strongly agreed that the repair costs less than replacement. Most of the participants (72.8%) stated that composite repair rather than total replacement reduces potential damage to the pulp and consequently, reduces the potential need for root canal treatment and crown. This finding is similar to another internationally conducted study.[28]

The mechanical roughening of the exposed restoration is the most commonly taught surface treatment by dental schools in the United Kingdom, Ireland[29], USA and Canada.[30]In contrast, 78% of the Japanese schools consider performing surface mechanical roughening does not have an affect on the clinical success of repair. Thus they rely on the chemical treatment.[31] The result of the present study showed that 43.3% of the clinicians rely on the chemical treatment of the exposed restoration surface with 37% phosphoric acid prior to repair material placement and

42% of dentists perform mechanical roughening of the old composite surface with diamond bur. This reflects that confusion concerning the appropriate surface treatment technique exists within clinicians.

Although resin repair techniques are considered debatable, the study results revealed that the majority of the dentists (72%) considered the repaired composite restoration as a permanent restoration. This is similar to a survey conducted in Pakistan where 65% of the participants reported that the repaired restoration is considered a permanent restoration.[32]

The low viscosity of flowable composites results in better adaptability with cavity walls, making them attractive for use in repair. However, caution should be exercised in terms of potential leakage and low mechanical properties.[33]Sixteen of eighteen schools in Japan reported that the preferred material for completing the repair was flowable composite.[31] In contrast, the majority of participants in our study (45.3%) indicated that they use both flowable and conventional composite for repair.

Despite the fact that 15.7% of the participants reported that they were not taught about composite repair, most of the participants (43.3% strongly agreed, 43.7% agreed) in Benghazi believe teaching of composite repair technique should be included in the academic curriculum. The majority of dental schools in Japan (95%),[31] USA and Canada (88%),[30]and the United Kingdom and Ireland 88% [29] teach their students restoration repair procedures in the curriculum. Forty one percent of clinicians agreed that involving the patient in decision making regarding repair or total replacement of the composite restoration is considered a good practice. Patients must understand that a repaired restoration is not a total replacement of the restoration and might be at risk of early failure.[9]

5. CONCLUSIONS

Resin composite repair is a well-established procedure among Libyan practitioners in Benghazi. It is considered a legitimate alternative to total restoration replacement. The advantages of this minimally invasive procedure include increased life span of the restoration, avoidance of unnecessary tooth structure loss and less pulpal tissue damage. Clear didactic and clinical instructions regarding resin composite repair technique should be included in the dental curriculum. Moreover, further clinical studies concerning the appropriate and standardized clinical techniques for performing resin composite repair should be carried out.

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7. REFERENCES

1. 1.Haj-Ali R, Walker MP, Williams K. 2005. Survey of general dentists regarding posterior restorations, selection criteria, and associated clinical problems. Gen Dent, 53(5):369-375; quiz 376, 367-368.

2. Magne P. 2006. Composite resins and bonded porcelain: the postamalgam era? J Calif Dent Assoc., 34(2):135-147.

3. Opdam NJ, Bronkhorst EM, Roeters JM, Loomans BA. 2007. A retrospective clinical study on longevity of posterior composite and amalgam restorations. Dent Mater., 23(1):2-8.

4. Sunnegardh-Gronberg K, van Dijken JW, Funegard U, Lindberg A, Nilsson M. 2009. Selection of dental materials and longevity of replaced restorations in Public Dental Health clinics in northern Sweden. J Dent., 37(9):673-678.

5. Hervas-Garcia A, Martinez-Lozano MA, Cabanes-Vila J, Barjau-Escribano A, Fos-Galve P. 2006. Composite resins. A review of the materials and clinical indications. Med Oral Patol Oral Cir Bucal., 11(2):E215-220.

6. Kubo S. 2011. Longevity of resin composite restorations. Japanese Dental Science Review., 47(1):43-55.

7. 7.Opdam NJ, Bronkhorst Em, Loomans BAC, Huysmans MC. 2010. 12-year survival of composite vs. amalgam restorations. J Den Res., 89:1063-1067

http://dx.doi.org/10.1177/0022034510376071.

8. Gordan VV, Riley JL, 3rd, Worley DC, Gilbert GH, Group DC. 2012. Restorative material and other tooth-specific variables associated with the decision to repair or replace defective restorations: findings from The Dental PBRN. J Dent., 40(5):397-405.

9. Blum IR, Jagger DC, Wilson NH. 2011. Defective dental restorations: to repair or not to repair? Part 1: direct composite restorations. Dent Update., 38(2) :78-80, 82-74.

10. Arhun N. TD. 2017. Repair of Direct Resin Composite Restorations. Dental Composite Materials for Direct Restorations. Springer, Cham 245–267.

11. Moncada G, Martin J, Fernandez E, Hempel MC, Mjor IA, Gordan VV. 2009. Sealing, refurbishment and repair of Class I and Class II defective restorations: a three-year clinical trial. J Am Dent Assoc., 140(4) :425-432.

12. Kallio TT, Tezvergil-Mutluay A, Lassila LV, Vallittu PK. 2013.The effect of surface roughness on repair bond strength of light-curing composite resin to polymer composite substrate. Open Dent J., 7:126-131.

13. Ozcan M, Alander P, Vallittu PK, Huysmans MC, Kalk W. 2005. Effect of three surface conditioning methods to improve bond strength of particulate filler resin composites. Journal of materials science Materials in medicine., 16(1): 21-7 http://dx.doi.org/10.1007/s10856-005-6442-4.

14. Nilsson E, Alaeddin S, Karlsson S, Milleding P, Wennerberg A. 2000. Factors affecting the shear bond strength of bonded composite inlays. The International journal of prosthodontics., 13(1):52-58.

15. Tyas MJ, Anusavice KJ, Frencken JE, Mount GJ. 2000. Minimal intervention dentistry--a review. FDI Commission Project 1-97. Int Dent J., 50(1):1-12.

16. Fernandez E, Martin J, Vildosola P, et al. 2015. Can repair increase the longevity of composite resins? Results of a 10-year clinical trial. J Dent., 43(2):279-286.

17. Hickel R, Brushaver K, Ilie N. 2013. Repair of restorations--criteria for decision making and clinical recommendations. Dent Mater., 29(1):28-50.

18. Gordan VV, Shen C, Mjor IA. 2004. Marginal gap repair with flowable resin-based composites. Gen Dent., 52(5):390-394.

19. Bonstein T, Garlapo D, Donarummo J, Jr., Bush PJ. 2005. Evaluation of varied repair protocols applied to aged composite resin. J Adhes Dent.,7(1):41-49.

20. Loomans BA, Cardoso MV, Roeters FJ, et al. 2011. Is there one optimal repair technique for all composites? Dent Mater.,27(7):701-709.

21. Tezvergil A, Lassila LV, Yli-Urpo A, Vallittu PK. 2004. Repair bond strength of restorative resin composite applied to fiber-reinforced composite substrate. Acta Odontol Scand.,62(1):51-60.

22. Gordan VV, Shen C, Riley J, 3rd, Mjor IA. 2006. Two-year clinical evaluation of repair versus replacement of composite restorations. J Esthet Restor Dent., 18(3):144-153; discussion 154.

23. Gordan VV, Garvan CW, Blaser PK, Mondragon E, Mjor IA. 2009. A long-term evaluation of alternative treatments to replacement of resin-based composite restorations: results of a seven-year study. J Am Dent Assoc., 140(12):1476-1484.

24. Gordan VV, Riley JL, 3rd, Geraldeli S, et al.2012. Repair or replacement of defective restorations by dentists in The Dental Practice-Based Research Network. J Am Dent Assoc., 143:593-601.

25. Fernández EM, Martin Ja, Angel PA, Mjör IA, Gordan VV, Moncada GA. 2011. Survival rate of sealed, refurbished and repaired defective restorations: 4-year follow-up. (1806-4760 Braz Dent J., 2011;22:134-9. doi: 10.1590/s0103-64402011000200008.

26. Sheiham A. 2002. Minimal intervention in dental care. Med Princ Pract., 11 Suppl 1:2-6. doi: 10.1159/000057772.

27. Fayyaz A, Fareed M, Ehsan S, Baig Q, Noor N. 2015. Repair or replacement of defective direct composite restorations: a survey of dentists. J Pak Dent Assoc., 24(1):17-21.

28. Blum IR, Schriever A, Heidemann D, Mjör IA, Wilson NH. 2003. The repair of direct composite restorations: an international survey of the teaching of operative techniques and materials. Eur J Dental Educ., 7(1):41-48.

29. Blum I, Lynch C, Wilson N. 2012. Teaching of direct composite restoration repair in undergraduate dental schools in the United Kingdom and Ireland. Eur J Dental Educ., 16:e53-58.

30. Lynch CD, Blum Ir, Frazier KB, Haisch LD, Wilson NH. 2012. Repair or replacement of defective direct resin-based composite restorations: contemporary teaching in U.S. and Canadian dental schools. J Am Dent Assoc., 143(2): 157-163.

31. Lynch Cd, Hayashi M, Seow LL, Seow Ll, Blum IR, Wilson NH. 2013. The management of defective resin composite restorations: current trends in dental school teaching in Japan. Open Dent J., 38(5): 497-504.

32. Muhammed Hassan FRK, Munawar Rahman. 2011. Teaching and practice of repair of resin composite restorations in dental institutions of Karachi. J PaK Dent Assoc., 20(4):216-221.

33. Tredwin CJ, Stokes A, Moles DR. 2005. Influence of flowable liner and margin location on microleakage of conventional and packable class II resin composites. Oper Dent., 30(1):32-8.