30 Months Clinical Evaluation of Posterior Composite Resin Restorations

Serdar Akarsu[1,*] and Hüseyin Özgür Özdemir[2]

[1]*Department of Restorative Dentistry, Faculty of Dentistry, Ordu Univercity, Ordu, Turkey*

[2]*Department of Endodontics, Oral and Dental Health Center, Ministry of Health, Ordu, Turkey*

Abstract: *Background/Purpose*: Popularity of tooth-colored restorations increased with the development of restorative materials and dentin adhesives in the last five years. The aim of this study was to evaluate two posterior composite resins (Surefil and Filtek[TM] P$_{60}$) for 30 months *in vivo*.

Materials and methods: In this study, 72 Class II restorations were placed in 62 patients. The restorations were evaluated and scored alpha according to USPHS criteria. 30 months later, the restorations were reevaluated by independent experienced examiner.

Results: Fisher Chi-Square test was used for the statistical analysis. After 30 months, both of the composite resins were found to be successful. There was no significant difference between two groups for marginal integrity, marginal leakage, abrasion resistance, surface texture, surface staining, post-operative sensitivity and seconder caries. However, Class II restorations of SureFil[TM] (Caulk / Dentsply, UK) were better than Filtek[TM] P$_{60}$ (3M ESPE, USA) for interproximal contact ($p < 0.05$).

Keywords: Posterior composite, clinical evaluation.

1. INTRODUCTION

The new generation restorative materials and dentin adhesives were introduced in 1990s and the popularity of tooth-colored restorations increased in the last five years. Today, decline of caries rate lead clinicians to prepare more conservative cavities. Interest for tooth-colored restorations in posterior teeth increased with the developments in adhesive technology and esthetic considerations [1].

Some manufacturers name posterior composites as "Condensable". "Condensable" is defined as able to be compacted or made denser by reducing volume. Unlike amalgam, composite resins can not be compacted or condensed. These materials are named as "packable" and stay where placed until light-curing [1-3].

The most common problem in direct composite restorations is polymerisation shrinkage [4] and microleakage can occur between tooth and restoration due to polymerization shrinkage [5]. As a result, the secondary caries, postoperative sensitivity, fracture and wear can occur [6, 7].

In packable composites, the filler particle size is larger than that of the hybrid composites. Resin matrices are modified to allow for an increase in the filler amount. Compared with hybrid composites, packable composites have high filler (SureFil[TM]: 82%, Filtek[TM] P60: 83%) [1].

Packed composites have less polymerization shrinkage than traditional composites due to their high density and reduced matrix structure. The coefficients of thermal expansion are close the teeth and the modulus of elasticity are close the amalgam. In this way, microleakage and the postoperative sensitivity and secondary caries due to microleakage can be prevented. The high wear rate seen in conventional composites is also reduced [8-11].

In packable composites, filler size is reduced, filler proportion is increased and resin matrix is modified to allow increase in filler amount. Wear resistance of these composites is better than old generation composites. In these composites, polimerization shrinkage was decreased by increasing the filler volume and so microgap was reduced to minimum. Moreover, some fillers were added to increase viscosity. Color stability of the composite restorations has enhanced with these developments. The restorations became highly polishable with the microparticles in the resin [3].

The physical properties of composites depends on resin matrix, filler particles and coupling agent. Chemical environment also effects this structure. Some nutrients and organic acids of plaque soften resin

*Address correspondence to this author at the Ordu University, Faculty of Dentistry, Department of Restorative Dentistry, Ordu, Turkey;
Tel: +90 4522121284; Fax: +904522121289; E-mail: serdarakarsu@odu.edu.tr

matrix [12]. Chemically softening of restorative materials may result in an increase of wear clinically [13-15].

The aim of this study was to evaluate clinical performance of two different packable posterior composite resins for 30 months.

2. MATERIALS AND METHODS

Patients (aged 21 to 29 years) were selected from Clinic of Department of Restorative Dentistry, University of Ondokuz Mayıs. In this clinical study, maxillary and mandibular premolars with aproximal dentin lesions were selected. For this reason, all carious lesions were Class 2 deep dentin caries. All teeth used in the study were vital, appeared normal on the radiograph and responded favorably to the pulp test. Seventy-two resin composite restorations were placed in sixty-two patients. Thirty-eight teeth were restored using SureFil[TM] (Caulk / Dentsply, UK.), thirty-four were restored using Filtek[TM] P60 (3M ESPE, USA) under anesthesia by one operator according to the manufacturers' instructions.

2.1. Group 1: SUREFIL[TM]

After complete removal of caries (residual caries were determined with visual method and diagnodent pen), cavity preparation was finished. Calcium hydroxide was not used prior to adhesive agent. Palodent PLUS sectional matrix system (Dentsply ,UK.) and wooden wedges were used for interproximal contact and contour. CLEARFIL SE BOND (Kuraray, USA) was applied on all cavity surfaces. The self-etching PRIMER was applied for 20 seconds. The BOND was then applied and light cured for 10 seconds. Then SureFil[TM] (Caulk / Dentsply, UK.) packable posterior composite was placed into the cavity incrementally. The first increment was horizontally placed at cervical wall. The second increment was obliquely placed contacting the buccal and axial walls and the previously cured increment. The third increment was obliquely placed, filling the preparation. All increments were light-cured for 40 seconds each.

2.2. Group 2: FILTEK[TM] P60

After complete removal of caries (residual caries were determined with visual method and diagnodent pen), cavity preparation was finished. Calcium hydroxide was not used prior to adhesive agent. Palodent PLUS sectional matrix system (Dentsply, UK.) and wooden wedges were used for interproximal contact and contour. CLEARFIL SE BOND (Kuraray, USA) was applied on all cavity surfaces. The self-

Table 1:   USPHS Criteria for Clinical Evaluation

Retention	Alpha	Present
	Bravo	Partial
	Charlie	Absent
Marginal Integrity	Alpha	Excellent continuity at resin- enamel interface; no ledge, no discoloration
	Bravo	Slight ledge or ditch at resin – enamel interface; detectable with explorer
	Charlie	Visible marginal ditch or ledge
	Delta	Actual separation of interface between resin and enamel
Marginal Leakage	Alpha	Excellent continuity at resin- enamel interface; no discoloration
	Bravo	Slight discoloration at resin – enamel interface
	Charlie	Moderate discoloration at resin- enamel interface measuring ≥1mm
	Delta	Recurrent decay at margins
Abrasion Resistance	Alpha	Completely intact with no perceptible loss of contour
	Bravo	Slight loss of contour not requiring replacement
	Charlie	Extensive loss of contour requiring replacement
Surface Texture	Alpha	Smooth and shiny
	Bravo	Smooth and dull
	Charlie	Grainy and rough
Surface Staining	Alpha	Absent
	Bravo	Present
Postoperative Sensitivity	Alpha	Absent
	Bravo	Present
Interproximal Contact	Alpha	Excellent: 0.075 mm paper cannot pass through contact
	Bravo	Fair: 0.075 mm paper can enter contact and pass with diffuculty
	Charlie	Failure: 0.075 mm paper passes through contact area without difficulty
Secondary Caries	Alpha	Absent
	Bravo	Present

etching PRIMER was applied for 20 seconds. The bond was then applied and light cured for 10 seconds. Then Filtek[TM] P60 (3M ESPE, USA) packable posterior composite was placed into the cavity incrementally. The first increment was horizontally placed at cervical wall. The second increment was obliquely placed contacting the buccal and axial walls and the previously cured increment. The third increment was obliquely placed, filling the preparation. All increments were light-cured for 20 seconds each.

For both groups, finishing and polishing procedures were performed using finishing and polishing discs (Soflex Pop-on, 3M ESPE, USA) and finishing strips (Moyco Industries Inc, USA).

All restored teeth were in occlusion with the natural dentition and had proximal contact with adjacent teeth.

The restorations were evaluated according to United States Public Health Service (USPHS) criteria (Table **1**) and were scored as Alpha. The restorations were reevaluated after 30 months by independent experienced examiner. Fisher Chi-square Test was used for the statistical analysis.

3. RESULTS

The results of reevaluation after 30 months according to USPHS criteria are shown in Table **2**. The

rate of Alpha scores indicated that both of the composite restorations were found to be successful. There was no significant difference between two groups for marginal integrity, marginal leakage, abrasion resistance, surface texture, surface staining, post-operative sensitivity and seconder caries. However, Class II restorations restored with SureFil (Caulk/ Dentsply, UK) were better than Filtek[TM] P60 (3M ESPE) for interproximal contact ($p < 0.05$). After 30 months of evaluation, 20 Filtek[TM] P60 (3M ESPE, USA) restorations were scored as alpha, 10 were scored as bravo for interproximal contact. However, 28 SureFil[TM] (Caulk / Dentsply, UK) restorations were scored as alpha, only 2 restorations were scored as bravo.

4. DISCUSSION

The longevity and functional properties of restorations are important factors to determine long-term effectiveness of invasive caries treatment. While early failure of restorations are determined by partial loss of filling material and bulk fractures, late failure is determined by proximal seconder caries [16,17].

A variety of clinical results were reported in a number of *in vivo* studies in which posterior composites were evaluated. Köhler *et al*. [18] evaluated class 2 restorations of Superlux Molar and APC Composite Systems for 5 years. At the baseline, all restorations

Table 2:   Results of Clinical Evaluation after Two Years

USPHS Criteria	Composite	Alpha	Bravo	Total (n)
Marginal Integrity	FILTEK P$_{60}$	24	6	30
	SUREFIL	20	10	30
Marginal Leakage	FILTEK P$_{60}$	22	8	30
	SUREFIL	26	4	30
Abrasion Resistance	FILTEK P$_{60}$	28	2	30
	SUREFIL	29	1	30
Surface Texture	FILTEK P$_{60}$	29	1	30
	SUREFIL	26	4	30
Surface Staining	FILTEK P$_{60}$	25	5	30
	SUREFIL	24	6	30
Postoperative Sensitivity	FILTEK P$_{60}$	20	10	30
	SUREFIL	24	6	30
Interproximal Contact	FILTEK P$_{60}$[*]	20	10	30
	SUREFIL[*]	28	2	30
Secondary Caries	FILTEK P$_{60}$	29	1	30
	SUREFIL	28	2	30

* $p < 0.05$.

were scored alpha. However, five years later 22%, 26% and 57% of them were scored alpha for anatomic form, marginal adaptation and marginal discoloration respectively.

Kelsey *et al*. [19] compared the physical properties of three condensable composites (Alert, Surefil and Solitaire) and two composite resins (Prodigy and Z-100) and reported that the best physical properties were observed for Alert and Surefil. Amore *et al*. [20] found no difference between SureFil[TM] (Caulk / Dentsply, UK) and Filtek[TM] P60 (3M Dental, USA) posterior composites for polymerisation shrinkage.

Bala *et al*. [21] compared the leakage in class II cavities restored with resin-based posterior composites. They reported that there was more leakage at gingival/dentin margins rather than occlusal/enamel margins. The difference between Filtek P60 (3M Dental, USA) and Surefil at occlusal/enamel margin was not significant. However, less leakage was observed at gingival/dentin margin for Filtek[TM] P60 (3M Dental, USA) than Surefil restorations.

Ernst *et al*. [22] performed restorations using Solitaire (Hareaus-Kulzer, Hanau, Germany) and reevaluated 3 years later. For anatomic form 70.9%, for marginal integrity 65.5% and for marginal discoloration 71.8% of the restorations were scored as alpha.

Geutsen and Schoeler [23] evaluated1109 Class I and II composite restorations for 4 years and reported alpha scores for 79.3% and bravo scores for 15.5% of the restorations. Cunha [24] studied the clinical performance of TPH (Caulk/Dentsply,UK) in class I cavities of primary teeth and scored 82% of restorations alpha and 18% of restorations bravo 30 months later.

Post-operative sensitivity is an important factor when evaluating success rate of posterior composite restorations. The main reason of post-operative sensitivity is excessive preparation of dentin. Clinician must be careful when sound dentin expose while preparing cavity since dentin tubules expose. It is important to cover tubules with bonding in order to reduce post-operative sensitivity [25]. In our study, post-operative sensitivity was observed in 10 teeth for Filtek[TM] P60 (3M ESPE,USA) group and 6 teeth for SureFil[TM] (Caulk/Dentsply,UK) group after completion of the restorations.

Perry and Kugel [26] reevaluated the SureFil[TM] (Caulk / Dentsply, UK) restorations after 2 years and reported minimal wear and no seconder caries. Placement technique of posterior composites is an important factor in success rate. Less gap occurs in dentin-resin interface with incremental technique rather than bulk technique [27]. For this reason, incremental technique was preferred in our study.

The clinical success of posterior composite restorations is not only depends on physical properties but occlusion, choice of patient and teeth, oral hygiene and habits of the patient, the type of resin and application technique and ability and experience of the operator. Patient factors such as caries activity should be considered either [12]. Because of this all restorations were performed by one operator and oral hygiene education was performed upon completion of restorations.

CONCLUSION

In conclusion, when SureFil[TM] (Caulk / Dentsply, UK) and Filtek P60 (3M ESPE, USA) restorations were reevaluated after 30 months, all restorations were clinically successful except three restorations in which seconder caries was detected. There was no significant difference between two groups for marginal integrity, marginal leakage, wear resistance, surface texture, surface staining, post-operative sensitivity and seconder caries. Class II restorations of SureFil[TM] (Caulk / Dentsply, UK) showed better results than Filtek[TM] P60 (3M ESPE, USA) restorations for interproximal contact. The results of this study showed that both of the materials are good alternatives of amalgam in posterior teeth.

ACKNOWLEDGMENTS

REFERENCES

[1]   Wakefield CW and Kofford KR. Advances in restorative materials. Dent Clin North Am 2001; 45: 7-27.

[2]   Christensen GJ. Sorting out the confusing array of resin-based composites in dentistry. J Am Dent Assoc 1999; 130: 275-277.
https://doi.org/10.14219/jada.archive.1999.0179

[3]   Jackson RD and Morgan M. The new posterior resins and a simplified placement technique. J Am Dent Assoc 2000; 131: 375-383.
https://doi.org/10.14219/jada.archive.2000.0182

[4]   Labella R, Lambrechts P, Van Meerbeek B and Vanherle G. Polymerization shrinkage and elasticity of flowable composites and filled adhesives. Dental Materials 1999; 15: 128-137.
https://doi.org/10.1016/S0109-5641(99)00022-6

[5]   Perdigão J. New developments in dental adhesion. Dent Clin of North Am 2007; 51: 333-357.
https://doi.org/10.1016/j.cden.2007.01.001

[6]   Major IA and Qvist V. Marginal failures of amalgam and composite resin restorations: 8-year finding. Journal of Dentistry 1998; 26: 311-317.
https://doi.org/10.1016/S0300-5712(97)00019-5

[7]   Sarret DC. Clinical challenges and the relevance of materials testing for posterior composite restorations. Dental Materials 2005; 21: 9-20.
https://doi.org/10.1016/j.dental.2004.10.001

[8]   Tung FF, Estafan D and Scherer W. Microleakage of a condensable resin composite: an in vitro investigation. Quint Int 2000; 31: 430-434.

[9]   Leinfelder KF. Posterior composite resins: the materials and their clinical performance. JADA 1995; 126: 663-672.
https://doi.org/10.14219/jada.archive.1995.0247

[10]   Cramer NB, Stansbury JW and Bowman CN. Recent Advances and Developments in Composite Dental Restorative Materials. J Dent Res 2011; 90(4): 402-416.
https://doi.org/10.1177/0022034510381263

[11]   Craig RG and Powers JM. Restorative dental materials. 11th Ed. St. Louis: The C.V. Mosby Co 2002; 231-257.

[12]   Hashemikamangar SS, Pourhashemi SJ, Talebi M, Kiomarsi N and Kharazifard MJ. Effect of organic acids in dental biofilm on microhardness of a silorane-based composite. Restor Dent Endod 2015; 40(3): 188-194.
https://doi.org/10.5395/rde.2015.40.3.188

[13]   Asmussen E. Softening of BISGMA-based polymers by ethanol and by organic acids of plaque. Scandanavian J Dent Res 1984; 92: 257-261.
https://doi.org/10.1111/j.1600-0722.1984.tb00889.x

[14]   McKinney JE and Wu W. Chemical softening and wear of dental composites. J Dent Res 1985; 64:1326-1331.
https://doi.org/10.1177/00220345850640111601

[15]   Yap AUJ, Low JS and Ong LFKL. Effect of food-simulating liquids on surface characteristics of composite and polyacid-modified composite restoratives. Oper Dent 2000; 25: 170-176.

[16]   Collins CY, Bryant RW and Hodge KLV. A clinical evaluation of posterior composite resin restorations: 8- year findings. J Dent 1998; 26: 311-317.
https://doi.org/10.1016/S0300-5712(97)00019-5

[17]   Gaengler P, Hoyer I and Montag R. Clinical evaluation of posterior composite restorations: The 10-year report. J Adhesive Dent 2001; 3: 1285-1294.

[18]   Köhler B, Rasmusson CG and Odman P. A five- year clinical evaluation of class 2 composite resin restorations. J Dent 2000; 28: 111-116.
https://doi.org/10.1016/S0300-5712(99)00059-7

[19]   Kelsey WP, Latta MA, Shaddy RS and Stanislav CM. Physical properties of three packable resin-composite restorative materials. Oper Dent 2000; 25: 331-335.

[20]   Amore R, Pagani C, Youssef MN, Anacuate NC and Lewgoy HR. Polymerization shrinkage evaluation of three packable composite resins using a gas pycnometer. Pesqui Odontol Bras 2003; 17: 273-277.
https://doi.org/10.1590/S1517-74912003000300013

[21]   Bala O, Üçtaşli B and Ünlü I. The leakage of class II cavities restored with packable resin–based composites. J Contemp Dent Pract 2003; 4: 1-11.

[22]   Ernst CS, Martin M, Stuff S and Willershausen B. Clinical performance of a packable resin composite for posterior teeth after 3 years. Clin Oral Invest 2001; 5: 148-155.
https://doi.org/10.1007/s007840100117

[23]   Geurtsen W. Schoeler UA. 4 year retrospective clinical study of class I and Class II composite restorations. J Dent 1997; 25: 229-232.
https://doi.org/10.1016/S0300-5712(96)00027-9

[24]   Cunha RF. A thirty months clinical evaluation of a posterior composite resin in primary molars. J Clin Pediatr Dent 2000; 24: 113-115.

[25]   Berkowitz G, Spielman H, Matthews A, Vena D, Craig R, *et al*. Postoperative hypersensitivity and its relationship to preparation variables in Class I resin-based composite restorations: findings from the practitioners engaged in applied research and learning (PEARL) Network. Part 1. Compend Contin Educ Dent 2013; 34(3): 44-52.

[26]   Perry RD and Kugel G. Two- year clinical evaluation of a high- density posterior restorative material. Compend Contin Educ Dent 2000; 21: 1067-1072.

[27]   Lopes GC, Baratieri LN, Monteiro S and Vieira LCCV. Effect of posterior resin composite placement technique on the resin-dentin interface formed *in vivo*. Quintessence Int 2004; 35: 2.