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Clinical Research

Clinical Evaluation of a Flowable Resin Composite and Flowable Compomer for Preventive Resin Restorations

M Qin • HS Liu

Clinical Relevance

Flowable resin composite and flowable compomer can be used for preventive resin restorations. The repair should be performed immediately, in case the preventive resin restoration develops a fracture or loss.

SUMMARY

This clinical study evaluated the retention and caries protection of a flowable resin composite (Flow Line) and a flowable compomer (Dyract Flow) used in preventive resin restorations as compared to the conventional preventive resin technique which uses a resin composite (Brilliant) and a sealant (Concise). This study observed 205 permanent molars with small carious cavities less than 1.5 mm in width, which were obtained from 165 children aged 7 to 15 years. Flowable resin composite was used to treat 75 teeth, and 71 teeth were treated with flowable compomer in both cavities and caries-free fissures. For the control group, 59 teeth were treated with resin composite in cavities and sealant in caries-free fissures. The teeth were evaluated at 3, 6, 12, 18 and 24-month intervals. After three months, all 205 treated teeth were completely intact. After six months, 66 of the 71 teeth treated with flowable resin composite and 65 of the 70 teeth treated with flowable compomer were complete, compared to 57 of the 58 teeth treated with the conventional preventive resin technique. After 12 months, 60 of the 67 teeth treated with flowable resin composite and 61 of the 67 teeth treated with flowable compomer were complete, compared to 51 of the 55 teeth treated with the conventional preventive resin technique. After 18 months, 53 of the 61 teeth treated with flowable resin composite and 54 of the 62 teeth treated with flowable compomer were complete, compared to 47 of the 53 teeth treated with the conventional preventive resin technique. After 24 months, 49 of the 58 teeth treated with flowable resin composite and 45 of the 57 teeth treated with flowable compomer were complete, compared to 42 of the 52 teeth treated with the conventional preventive resin technique. There were no statistically significant differences in retention rates among all

*Man Qin, DDS, PhD, clinical professor and associate professor, Department of Pediatric Dentistry, Peking University School and Hospital of Stomatology, Beijing, China

HongSheng Liu, DDS, MS, lecturer, Department of Pediatric Dentistry, Peking University School and Hospital of Stomatology, Beijing, China

*Reprint request: Zhongguancun South Avenue 22, Haidian District, Beijing 100081, China; e-mail: qinman@gmail.com

groups after 3, 6, 12, 18 or 24-months ($p>0.05$). One tooth treated with flowable resin composite and one tooth treated with flowable compomer developed caries after 18 and 24 months, respectively, resulting from partial loss at "caries-free fissures." Five teeth developed caries in the conventional preventive resin group; one after 12 months, two after 18 months and one after 24 months, due to loss at cavities. The final caries occurred after 24 months, resulting from partial loss at "caries-free fissures." The differences in caries development among the three groups were not statistically significant ($p>0.05$). This study suggested that flowable resin composite and flowable compomer could be used for preventive resin restorations. Meanwhile, a vigilant recall should be followed-up due to the risk of failure for flowable materials in "caries-free" fissures. The repair should be performed immediately, in case the preventive resin restoration develops a fracture or loss.

INTRODUCTION

The preventive extension of cavities in the treatment of occlusal caries for permanent molars in children has been in use for some time. According to preventative extension, all pits and fissures are eradicated with a bur when the tooth is prepared in order to ease the placement of amalgam. This means that some non-carious tooth structure is sacrificed during placement. Fortunately, a better understanding of the caries process and remineralization have catalyzed the evolution in caries management from GV Black's "extension for prevention" to "minimally invasive" (Murdoch-Kinch & McLean, 2003). Simonsen (1978a) described a minimally invasive preparation and restoration, which he named the preventive resin restoration. This preparation only removed carious pits and fissures, using small burs, with tooth removal barely reaching into dentin; in some cases, only enamel was removed. The tooth was restored using an adhesive technique with a highly filled resin composite for the prepared pits and fissures, covering the remaining pits and fissures with a sealant (Simonsen, 1985). One problem with the preventive resin technique was that it required the use of two different materials.

From the time that a flowable resin composite was first described by Ibsen (1972) for use in restoring cervical erosion, flowable resin composites have been used to solve clinical problems, often in situations where no specific material had previously served. These materials have been used as the repair material for non-carious amalgam margin defects (Roberts, Charlton & Murchison, 2001), as stress-relieving gingival increments in Class II restorations (Malmstrom & others, 2002; Estafan, Estafan & Leinfelder, 2000), as pit and fissure sealants (Autio-Gold, 2002) or to bond together chipped teeth for a long-term temporary emergency (Small, 1996).

Flowable materials are a modification of restorative resins; thus, they tend to contain lower filler content and more of a resin matrix. Flowable composites are easier to place and more self-adaptable compared to conventional restorative resin composites. These flowable materials have a viscosity that allows them to be used for minimally invasive preparations and also as a sealant for the untouched part of the occlusal surface. When flowable resin composites were first introduced, they appeared to be a one-dimensional restorative material used in preventive resin restorations. Flowable compomers are polyacid-modified resin composites that possess the characteristics of both flowable composites and glass ionomers. Flowable compomers claim to improve the adhesive and fluoride-releasing properties of conventional glass ionomer cements, while also retaining the esthetic properties of conventional glass ionomer cements. As preventive resin restorations have evolved, flowable resin composites and flowable compomers have become a logical choice for restoring these lesions.

This clinical study evaluated the retention and caries protection of a flowable resin composite (Flow Line, Heraeus Kulzer GmbH, Wehrhein, Germany) and a flowable compomer (Dyract Flow, Dentsply Inc, Milford, DE, USA) for preventive resin restorations compared to the conventional preventive resin technique (Simonsen 1978b).

METHODS AND MATERIALS

The subjects were recruited from patients seeking routine dental care at the Department of Pediatric Dentistry, Stomatological Hospital, Peking University between 2000 and 2001. The subjects selected for this study included 165 children, 79 boys and 86 girls, aged 7 to 15 years, with an average age of 10 years and 5 months with 205 permanent molars containing small carious lesions. The procedures and potential discomforts, risks and benefits were explained to the parents, and their informed consent was obtained.

The width of the small carious cavities was limited to 1.5 mm, controlled by a small round bur (No 2 round bur, IOS #010, Thomas, FFDM Pneumat, Bourges Cedex, France), with no limitation on depth. The restoration preparation only removed the carious lesions using small burs (No 1/2 round bar, ISO #006; No 1 round bur, ISO #008 and No 2 round bur ISO #010, Thomas, FFDM Pneumat). The carious cavities extended no further than the medium third of the dentin. The cavities were recorded on a "sketch map" of occlusion surfaces in order to be re-checked easily during the follow-up examination. The teeth were etched for 30 seconds with a 20% phosphoric acid etchant (Heraeus

Table 1: *Number of Restoration Reviewed and Recall Rate Percentages*

	Baseline	Three Months	Six Months	12-Months	18-Months	24-Months
Flowable Composite Resin Group	75	75(100%)	71(94.7%)	67(89.3%)	61(81.3%)	58(77.3%)
Flowable Compomer Group	71	71(100%)	70(98.6%)	67(94.4%)	62(87.3%)	57(80.3%)
Conventional PRR Group	59	59(100%)	58(98.3%)	55(93.2%)	53(89.8%)	52(88.1%)
Total Teeth	205	205(100%)	199(97.1%)	189(92.2%)	176(85.9%)	167(81.5%)

Table 2: *Distribution of Retention Rates and Recurrent Caries Rates*

Groups	Flowable Composite Resin Group					Flowable Compomer Group					Conventional PRR Group				
Score	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
3-month	75 100%					71 100%					59 100%				
6-month	66 93.0%	5 7.0%				65 92.9%	5 7.1%				57 98.3%		1 1.6%		
12-month	60 89.9%	7 10.1%				61 91.0%	6 9.0%				51 92.7%		3 5.5%		1 1.8%
18-month	53 86.9%	7 11.6%		1 1.5%		54 87.1%	8 12.9%				47 88.7%	1 1.9%	3 5.7%		2 3.8%
24-month	49 84.5%	7 12.1%	2 3.4%			45 78.9%	8 14.0%	3 5.3%	1 1.8%		42 80.8%	3 5.8%	5 9.6%	1 1.9%	1 1.9%

0 - intact restoration
1 - complete restoration at the cavity with fracture or loss at the caries-free fissure, but no caries development
2 - incomplete restoration at the cavity but no caries development
3 - complete restoration at the cavity with a fracture or loss at the caries-free fissure with caries development
4 - incomplete restoration at the cavity with caries development

Kulzer GmbH, Wehrhein, Germany), then rinsed for 20 seconds with an air-water spray and dried, leaving the dentin slightly moist. In the conventional preventive resin group, the cavities were treated with resin adhesive (Single Bond Adhesive, 3M Dental Products, St Paul, MN, USA) and polymerized for 20 seconds using a curing light (Spectrum, Dentsply Inc, Milford, DE, USA) with an output intensity $\geq 420 mW/cm^2$. The preparations were then restored with a micro-hybrid resin composite (Brilliant, Coltène/Whaledent Inc, Altstatten, Switzerland) and polymerized for 40 seconds. The remaining caries-free pits and fissures were re-dried for a few seconds, until the surface was chalky white and covered with a sealant (Concise, 3M Dental Products) (Figure 2). In the flowable resin composite and flowable compomer groups, all pits and fissures were coated with Single Bond adhesive and polymerized for 20 seconds. Following the coating with adhesive, the flowable resin composite (Flow Line) and flowable compomer (Dyract Flow) were dispensed carefully, avoiding air bubbles by using the needle provided by the manufacturer, and polymerized for 40 seconds (Figure 1). The occlusion was adjusted in the three groups. Careful moisture control was maintained by using accepted cotton-roll-isolation procedures and a chair-side assistant.

Two hundred and five teeth from 165 children were treated at baseline. After three months, 165 children with 205 teeth were available for evaluation. After six months, 160 children with 199 teeth were evaluated; after 12 months, 151 children with 189 teeth were evaluated; after 18 months, 139 children with 176 teeth were evaluated and after 24 months, 130 children with 167 teeth were available for evaluation (Table 1). Further evaluations were not performed, due to the excessive dropout rate. The primary reasons for dropout included family relocation or refusal to continue in the study.

The examination for restoration retention rate and caries protection were conducted using the following criteria:

0—intact restoration.

1—complete restoration at the cavity, with fracture or loss at the caries-free fissure, but no caries development.

2—incomplete restoration at the cavity but no caries development.

3—complete restoration at the cavity, with a fracture or loss at the caries-free fissure with caries development.

4—incomplete restoration at the cavity, with caries development.

The retention, condition of the restorations and caries were evaluated with a dental explorer under visual inspection. Incomplete restorations were not reapplied between examinations until the definition of caries was met.

A contingency table and a mixed model were used for data analysis. Fisher's Exact Test was used to compare the types of materials for retention rates and caries increments.

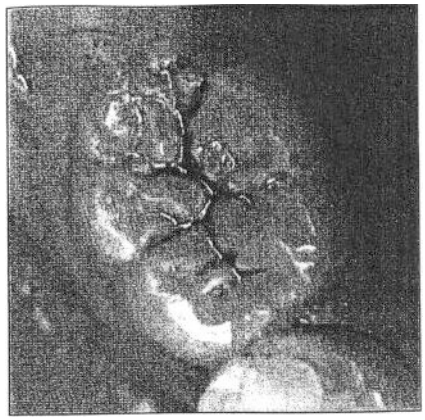

Figure 1. *The clinical process of preventive resin restoration with flowable materials.* Figure 1A: *A mandibular first permanent molar with small caries lesion in occlusal fissure.*

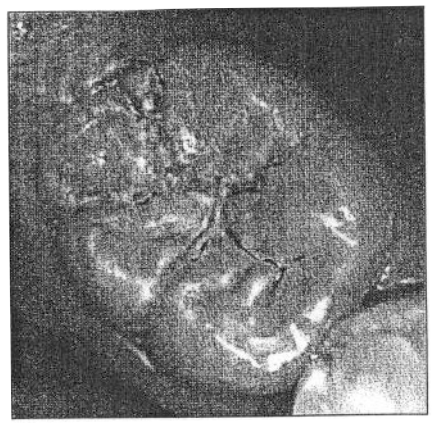

Figure 1B. *The restoration preparation only removes carious lesion without any extension into the surrounding healthy tooth structure. The width of the cavity is limited to 1.5 mm, with no limitation on length.*

Figure 1C. *The tooth is etched for 30 seconds with 20% phosphoric acid etchant.*

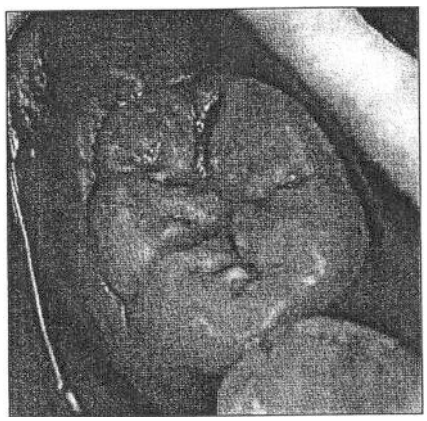

Figure 1D. *The tooth is rinsed for 20 seconds with an air-water spray and dried, leaving the dentin slightly moist.*

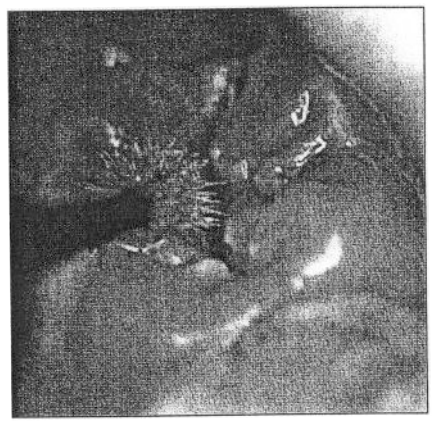

Figure 1E. *The cavity and caries-free pits and fissures are treated with Single Bond Adhesive.*

Figure 1F. *The flowable material is dispensed carefully, avoiding air bubbles by using the needle provided by the manufacturer.*

Figure 1G. *The preventive resin restoration with flowable compomer is performed on the mandibular first permanent molar.*

RESULTS

The distribution of retention and caries development after 3, 6, 12, 18 and 24 months is shown in Table 2. After three months, all 205 treated teeth were completely intact. After six months, 66 of the 71 teeth treated with flowable resin composite and 65 of the 70 teeth treated with flowable compomer were complete compared to 57 of the 58 teeth treated with the conventional preventive resin technique. After 12 months, 60 of the 67 teeth treated with flowable resin composite and 61 of the 67 teeth treated with flowable compomer were complete compared to 51 of the 55 teeth treated with the conventional preventive resin technique. After 18 months, 53 of the 61 teeth treated with flowable resin composite and 54 of the 62 teeth treated with flowable compomer were complete compared to 47 of