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*Anna Ogonowska[1], Sylwia Falkowska[1], Anna Oreszczuk[1], Katarzyna Sokołowska[2], Elżbieta Łuczaj-Cepowicz[2], Grażyna Marczuk-Kolada[2]

Clinical evaluation of carious cavity restorations using Vertise Flow – 2-year observations

[1]Specialist Dental Surgery of Medical University of Białystok Sp. z o.o.
Head of Surgery: Anna Klimiuk, MD, PhD
[2]Department of Paediatric Dentistry, Medical University of Białystok
Head of Department: Grażyna Marczuk-Kolada, MD, PhD

Keywords

Vertise Flow, carious cavities, modified Ryge's scale, permanent dentition

Summary

Introduction. The introduction of self-adhesive materials in dentistry has significantly reduced the duration of filling carious cavities. This group includes a light-curing, semi-liquid composite material from Kerr, called Vertise Flow.
Aim. The aim of the study was clinical evaluation of restorations made using Vertise Flow in class I cavities in permanent teeth.
Material and methods. In children aged 8-17 years, 154 cavities were filled with Vertise Flow. After 2 years, 49 fillings were clinically evaluated according to the modified Ryge's criteria. The anatomical shape, colour, smoothness, marginal integrity of restorations and the evidence of secondary caries were assessed.
Parents or legal guardians of the children consented to the medical procedures.
Results. All the evaluated restorations were found retained, with acceptable anatomical shape and smoothness. One restoration slightly changed the colour, and unacceptable marginal integrity was seen in 2 cases. Secondary caries involved 2 teeth.
Conclusions. In this 2-year observation, Vertise Flow meets the requirements for materials used for filling minimally prepared class I carious cavities in permanent teeth of young patients.

Introduction

Flowable composite materials were introduced in dentistry in the 1990s (1). They have rheological and self-adapting properties, and are characterised by lower viscosity compared to conventional composites as they contain 20-25% less filler. They exhibit good marginal integrity and a low elasticity module. Moreover, most of these materials are contrasted on X-ray and have aesthetic effects (2).

Vertise Flow is a self-adhesive, light-curing and semi-liquid composite from Kerr, with its formulation based on the OptiBond technology. It is available in 9 shades (3). The composite contains phosphoric acid methacrylate ester and a monomer, glicerodimethacrylate phosphate (GPDM) (4). According to the manufacturer, this material bonds with mineralised dental tissue via two mechanisms. The first involves chemical interaction between calcium ions of these tissues and functional phosphate groups in GPDM contained in the composite. The other is based on tissue micromechanic etching, facilitated by low pH of the filling material (pH = 1.9) (5). However, the use of this type of composite is restricted to special clinical situations. According to the manufacturer, Vertise Flow is indicated for small Black's class I and V caries lesions, as a liner under class I and II restorations, as a sealant for pits and fissures, and for repair of enamel defects, porcelain restorations and incisal abrasions. The introduction of self-adhesives has significantly shortened the duration of application, which seems to be significant as for procedures conducted in paediatric patients (2, 3, 5).

Aim

The aim of the study was to conduct a two-year clinical observation of Black's class I restorations in permanent teeth, performed with the use of Vertise Flow.

Material and methods

Between 20 January 2015 and 28 December 2015, Vertise Flow (VF) was used in 154 restorations in patients reporting for dental treatment to the Department of Paediatric Dentistry of the Medical University of Białystok,

Poland. Parents or legal guardians of the children consented to the medical procedures. Patients older than 16 years of age also expressed consent themselves. Cavities were prepped in accordance with the current principles, with minimal removal of carious tissue (minimally invasive technique). They were opened with diamond burrs on fast-speed handpieces, and carious tissue was removed using carbide burrs on slow-speed handpieces. After cavity preparation, the material, adjusted to tooth shade, was applied directly from a syringe with an application tip. The material was subsequently spread with a brush for 15-20 seconds, and then cured for 20 seconds using a halogen polymerisation lamp. The duration of light-curing was longer (40 seconds) only for shades A3.5 and Universal Opaquer. Excess material was removed with a diamond-coated burr on a slow-speed handpiece, and subsequently the restoration was polished.

Two years later, the Vertise Flow restorations were inspected visually and tactually. Again, consent of the parents/legal guardians and patients over 16 years of age was obtained. No other medical procedures were conducted during the assessment. When the filling needed replacement, the patients were informed accordingly.

Clinical follow-up involved 45 children, both girls and boys, aged 8 to 17 years (age on the day of examination). Evaluations were made for Black's class I restorations in permanent teeth, with superficial and moderate caries diagnosed prior to Vertise Flow application. Restorations of other classes in permanent dentition and restorations in primary dentition were not subject to assessment due to their low number in patients who reported for follow-up. In 40 children and adolescents who met the criteria, 49 restorations were evaluated (tab. 1). The examination was conducted by two examiners using a mirror and an explorer in artificial lighting, with the assessment based on the modified Ryge's criteria (tab. 2) (6-8). Prior to the assessment, the results of one examiner and between two examiners were calibrated based on 20 restorations.

Restorations with scores 0 and 1 were considered clinically acceptable, whilst those with scores 2 and 3 were not deemed acceptable and needed to be replaced: replacement could be postponed in score 2 restorations and had to be done immediately in score 3 restorations. All restorations with secondary caries were selected for replacement.

Results

The results concerning the quality of restorations and the presence of secondary caries are presented in tables 3 and 4.

Vertise Flow restorations were found retained in all patients who reported for the follow-up. In the examinations,

Tab. 1. The study material with a division into tooth groups

Number of examined teeth		Upper	Lower	Total
Premolars	4	9	3	19
	5	3	4	
Molars	6	6	18	30
	7	3	3	

Tab. 2. Modified Ryge's criteria

Parameter	Modified evaluation criteria
Anatomic form	0 – the restoration is a continuation of the anatomic form of a tooth 1 – minor overhangs or fillings that do not reach the ridge; height of occlusion is locally decreased 2 – a discontinuous filling exposes the dentine or base; incomplete occlusal contact 3 – partial or complete absence of filling; lost occlusal contact; this is a reason of pain in the tooth or periodontium
Colour	0 – no discoloration 1 – small localised discoloration, easy to remove 2 – discoloration requiring a more major intervention 3 – significant discoloration that cannot be repaired
Roughness	0 – the surface is smooth 1 – the surface is slightly rough; smoothness can be restored by polishing 2 – the surface is rough; smoothness cannot be restored by polishing 3 – the surface is coarse, rough
Marginal integrity	0 – the explorer tip does not catch on the filling edges 1 – a crevice along the filling exposes the enamel 2 – a crevice along the filling exposes the dentine or base 3 – the filling is movable, fractured or missing entirely
Secondary caries	0 – no evidence of secondary caries along the margin of the restoration 1 – evidence of secondary caries along the margin of the restoration

Tab. 3. Assessed parameters of the examined restorations

Criteria of the modified Ryge's scale	Acceptable filling		Unacceptable filling	
	0	1	2	3
Anatomical form	46 (93.8%)	3 (6.2%)	0 (0.0%)	0 (0.0%)
Colour	37 (75.5%)	11 (22.5%)	1 (2.0%)	0 (0.0%)
Smoothness	28 (57.1%)	21 (42.9%)	0 (0.0%)	0 (0.0%)
Marginal integrity	38 (77.5%)	9 (18.4%)	2 (4.1%)	0 (0.0%)

Tab. 4. Clinical assessment of secondary caries

Secondary caries	None (0)	Present (1)	Total
Number and percentage of restorations	47 (95.9%)	2 (4.1%)	49 (100.0%)

it was noted that a very good shape of restorations, which constituted the continuation of the anatomic shape, was found in 46 cases, while minor correction was needed in 3 cases. Acceptable colour was seen in 48 restorations, including 37 with score 0 and 11 with score 1. One restoration was unacceptable. Smoothness was another evaluated parameter. It was acceptable for all restorations. The surface of 21 restorations showed slight roughness that could be eliminated by polishing. Marginal integrity was very good in 38 cases, which was represented by the fact that the explorer did not catch on the filling margins. The need for minor correction was noted in 9 cases. In 2 restorations, marginal integrity was not acceptable due to a visible crevice along the filling, exposing the dentine. Moreover, secondary caries was found in 2 of 49 teeth (tab. 4).

The results are illustrated in figure 1.

Discussion

Materials introduced to the market undergo numerous assessments in both *in vitro* and *in vivo* settings. The laboratory conditions vary considerably from the oral environment where various factors, such as saliva and its constituents, bacteria, plaque, as well as physical, chemical and electrical factors, do play a significant role (9). That is why clinical studies, which are much more difficult to conduct, seem to be more reliable. Despite high popularity of the Vertise Flow composite, which was investigated in this study, there are few works reporting long-term clinical observations. Sabbagh et al. evaluated features of this composite in *in vivo* settings after two years. They examined 34 Black's class I restorations in permanent molars of patients aged 6-12 years, using the Ryge's modified scale (9). Moreover, Marzec et al. have

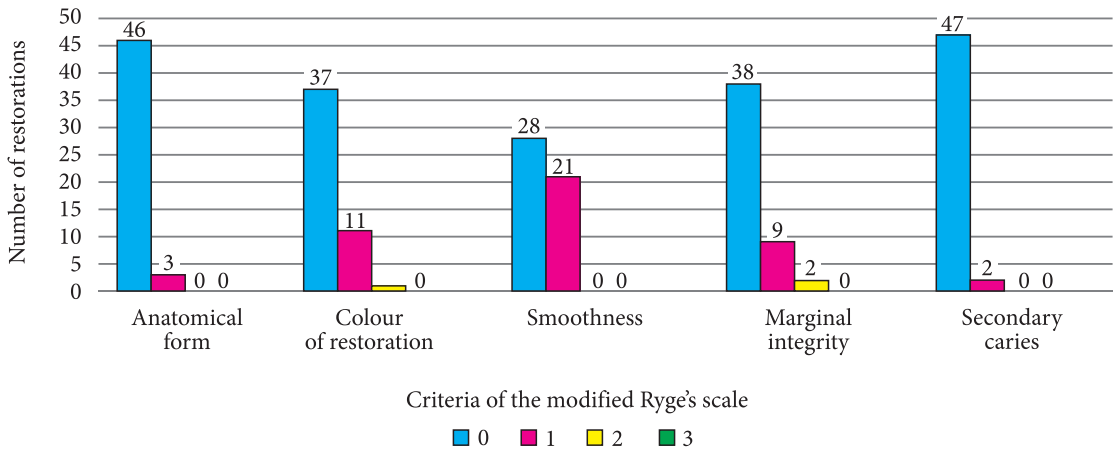

Fig. 1. Number of restorations depending on the assessed parameter

performed a preliminary clinical evaluation of 30 minor Black's class I Vertise Flow restorations in premolars and molars at 3 months. As in the present study, they used the Cvar and Ryge's criteria (10).

Vertise Flow has rheological properties, characterised by, among others, self-adaptation. Owing to the semi-liquid consistency, it adapts to the cavity walls, does not flow beyond its margins and does not require the use of additional instruments (2). These properties guarantee satisfactory anatomical form. In the present study, 46 (93.8%) restorations received the highest scores. Similar, though slightly worse, scores were noted by Sabbagh et al. (79.4%) and Marzec et al. (83.3%) (9, 10).

In our clinical evaluations, we noticed acceptable smoothness of all restorations, with 21 showing minor roughness. The highest score was assigned to only 28 (57.1%) restorations. Other authors obtained better results: Sabbagh et al. assessed 76.5% of restorations as perfectly smooth, while Marzec et al. reported the value of 86.7% in their 3-month observation (9, 10).

The literature contains studies that investigate a relationship of mechanical properties of the product, including its smoothness, with water sorption and desorption. Wei et al. published results concerning this issue relative to Vertise Flow and other composites (11, 12). The authors compared the behaviour of composite samples during water sorption and desorption cycles. The experiment lasted for 190 days, including 150 days of sample immersion in water and 40 days of drying. Based on their results, they concluded that Vertise Flow was characterised by the highest water sorption index, which results in insufficient smoothness of restorations. Water sorption of composites depends on multiple factors. The first and the most important is a polymer with the type of its monomer and degree of conversion. Another factor is the filler: its fraction, type, size and molecular morphology, as well as the degree of dispersion in the matrix. The remaining factors affecting sorption are catalyst concentration, initiator system and properties of resin-filler combination. According to the authors, the cause of high water sorption is the structure of GPDM which is present in, among others, Vertise Flow. It contains one or more polimerisable groups and additional functional groups in the form of acidic phosphate groups. They are combined by dedicated spacer groups. This structure determines hydrophilicity, swelling properties, flexibility and stiffness of materials. Moreover, it has an impact on their solubility, viscosity, wetting and penetration (13).

Furthermore, Arregui et al. confirmed in *in vitro* settings that Vertise Flow shows the highest water sorption compared with 8 other flowable materials in a six-month period. The authors noted an over 3-fold increase in water uptake by VF and significantly greater solubility of its components in water compared with other products (14).

When evaluating the quality of restorations, attention is also paid to their colour stability. The tendency to discolorations due to effects of internal and external factors, such as coffee, tea, red wine or orange juice, is one of the drawbacks of composite materials (14-18). There are no uniform opinions about the causes of this phenomenon. Most authors suggest a relationship of colour stability with water sorption. Ergücü et al. claim that high tendency to water absorption is strictly related to the susceptibility of composites to a colour change (16). Similar conclusions have also been drawn by other authors, including Barutcigil and Yıldız. They believe that water contributes to damage of the restoration's matrix by dissolving its monomers and oligomers, thus leading to the occurrence of empty spaces and microfractures (11, 12, 19).

Moreover, a team of Spanish and Italian researchers performed a 6-month analysis of the effects of water and food colour additives on composite samples, including Vertise Flow (14). Their results show that there is no statistically significant relationship between water sorption and colour change for Vertise Flow. Despite a significantly higher water uptake compared with other materials, Vertise Flow was characterised by high colour stability. According to these and other authors, colour changes of composites may be associated with the amount of contained filler. It is claimed that composites containing more than 70% by weight of filler are characterised by high colour stability. This group also includes Vertise Flow (18). Our results are in line with the conclusions of these authors as after 2 years of use, almost all the restorations had satisfactory colours. Discoloration requiring a more major intervention was noted in only one case. In the present study, 37 (75.5%) restorations received the highest scores. Similar, though slightly better, scores were noted by Sabbagh et al. (82.4%) and Marzec et al. (96.7%) (9, 10).

Marginal integrity of restorations is a significant clinical feature. It can be obtained via various methods. The most common is a 3-stage adhesive procedure, consisting in the use of phosphoric acid as an etching agent, primer and bond (20-22). A simplified procedure, using self-etching systems, is less common (23, 24). The introduction of self-adhesive composites which do not require etching, primer application and bond use has been a consequence of actions aiming to simplify and shorten the duration of handling a given material. These adhesives include Vertise Flow, investigated in this study. The quality of bonding with the dental tissue can be evaluated both in clinical and laboratory settings. Hamdy has evaluated marginal integrity by determining the penetration of ammoniacal silver nitrate solution (pH = 9.5) in the restorations. The studies concerned two materials: self-adhesive Vertise Flow and Te-Econom Plus, applied with a traditional technique with etching and bonding. The author showed that Vertise Flow restorations had worse marginal integrity as they were characterised by greater penetration of silver particles into the restoration (25). Different observations were made by Abdelwahed et al. who conducted a six-month study that

yielded an insignificantly lower value of bonding strength of Vertise Flow compared to a liquid composite with a nanofiller (26). Furthermore, Bektas et al. compared bonding strength and microleakage of the following systems: Vertise Flow (VF), Vertise Flow + OptiBond (OVF) and Revolution + OptiBond (OR). OVF samples obtained the best results for bonding strength to the dentine. Moreover, Vertise Flow without any bonding system was characterised by similar marginal integrity to the composite (Revolution) used together with the Optibond system (27).

Vichi et al. analysed marginal integrity of Vertise Flow restorations in *in vivo* settings. Using the Ryge's scale, the authors assessed 40 minor class I restorations in permanent dentition of patients aged 18-60 years of age. After six months, 92.5% of restorations received the highest score, while minor defects in marginal integrity and discolorations concerned two restorations (28). In their 3-month observations, Marzec et al. noted perfect marginal integrity in 96.7% of cases, while Sabbagh et al. observed this in 50.0% of cases after 2 years (9, 10). In our assessments, 47 restorations had acceptable marginal integrity, including ideal integrity in 38 cases (77.5%). This parameter was unacceptable in only two cases, and these restorations needed replacement.

In the present study, restorations were applied using isolation with lignin rolls. Sabbagh et al. noted in their randomised 2-year trial evaluating Vertise Flow that the use of lignin rolls for isolation, compared with a rubber dam, does not affect the quality and maintenance of an applied filling (9).

In light of our results, Vertise Flow meets the requirements of contemporary dentistry. Final conclusions about the quality and usefulness of this composite require longer assessment. That is why, research should be continued.

Conclusions

In this two-year clinical observation, Vertise Flow meets the requirements for materials used.

Conflict of interest

None

Correspondence

*Anna Ogonowska
Zakład Stomatologii Dziecięcej
Uniwersytet Medyczny w Białymstoku
ul. Waszyngtona 15a, 15-274 Białystok
tel.: +48 (85) 745-09-56
anna.ogonowska.dent@gmail.com

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