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Filtek supreme – handling and clinical properties of the nanocomposite after the 12-month observation period

Nowadays the reconstructive dentistry searches for the materials which would meet the increasingly higher demands of dentists and patients. The patients are mostly interested in the long-term cosmetic effects and durability of fillings. The dentists expect an universal material to combine the merits of aesthetics and resistance, to have excellent handling properties and to be suitable for all classes of fillings (Black's classification).

According to the manufacturer, the 3M ESPE Filtek Supreme nanocomposite fulfils the majority of the above-mentioned expectations. It is produced on the base of bis-GAMA, TEGDMA and bis-EMA resins and contains the 10^{-3}-mm nanofillers. These particles are combined with zirconium particles forming bigger nanoclusters, about 1 μm in size. The filler amount in Filtek Supreme is similar to that in traditional hybrid materials (11, 13).

The aim of the study was to examine the handling properties of Filtek Supreme during filling and to evaluate it clinically immediately after and 12 months after the procedures.

MATERIAL AND METHODS

The study was performed in the group of 36 patients (25 females and 12 males) aged 20–47 years who underwent 105 filling procedures. The majority of fillings (102) were inserted into carious cavities while 3 into non-carious cavities. Eight teeth were filled after endodontic treatment and 26 after secondary dental caries preparation. The study material is presented in Table 1. The cavities were prepared using the tissue sparing technique. In vital teeth a single glass ionomer or polycarboxylate cement lining was used; in deep cavities the calcium hydroxide preparations were additionally applied. Prior to the filling procedure, the self-etch adhesive system (3M ESPE Adper Prompt L-Pop) (12) was used, which belongs to generation VI of bonding systems. The "non-rinse" system eliminates the activities connected with rinsing and drying of cavities, shortens the time and minimizes the risk of possible errors (7). The cavities prepared in such a way were filled with Filtek Supreme and cured with the halogen lamp according to the manufacturer's instructions. The polymerized fillings were handled routinely.

The evaluation of handling properties of the material was based on physical features observed during insertion and preparation of fillings. The questionnaire filled in by dentists directly after the procedures was used. The questionnaire assessed the material according to 4 categories: A – insertion, adhesion to the wall and condensation, B – surface modelling in the non-polymerized material, C – precision of preparation (removal of the excess, surface finishing, polishing), D – shade selection (difficulties, duration, transparency).

Table 1. The study material assessed immediately after filling procedures

Type of hard tissue cavities	Class of cavities according to Black	Number of fillings	
		n	%
Carious cavities	I	10	9.52
	II	44	41.90
	III	36	34.29
	IV	4	8.81
	V	8	7.62
Non-carious cavities	wedge cavities	3	2.86
Total		105	100

Each category was assessed according to the four-degree scale: very good, good, quite good and negative. The follow-up evaluation of the handling properties of Filtek Supreme was performed immediately after the procedure and 12 months later. One year after the procedures 88 out of 105 fillings were examined, which constitutes 83.8% of primary restorations. The remaining fillings were not available as the patients did not come to their follow-ups. The compilation of the study material after 12 months is presented in Table 2.

Table 2. The study material assessed at 12 months

Type of hard tissue cavities	Class of cavities according to Black	Number of fillings after 12 months	
		n	%
Carious cavities	I	7	7.95
	II	35	39.77
	III	31	35.23
	IV	4	4.45
	V	8	9.09
Non-carious cavities	wedge cavities	3	3.41
Total		88	100

In both examinations (immediately after and 12 months after the filling procedures) the Ryge's scale was used and the following filling features were assessed: • the surface (criteria: colour, finish, gloss, discolorations) • the anatomical shape (criteria: reconstruction of the anatomical shape, cusps and contact area) • marginal adhesion (criteria: the presence of the marginal space, discolorations, slits, defects of the filling margins, secondary dental caries).

Each of the above-mentioned features was assessed according to the following scale: 0 – ideal filling, 1 – proper filling after slight correction, 2 – postponed refilling, 3 – immediate refilling. The scores 0 and 1 were considered acceptable while 2 and 3 unacceptable (10).

RESULTS

The handling properties of Filtek Supreme evaluated immediately after filling procedures are presented in Table 3. In all categories examined (A–D) the majority of evaluation scores were very good and good. The insertion of the material and its adhesion to the walls (A) were considered extremely high – 93 fillings (88.57%) evaluated as very good. Twelve fillings (11.43%) were assessed as good due to low plastic consistency and longer condensation requiring more strength. The modelling of the anatomical surface of the tooth in the non-polymerized material (B) was assessed as very good in 79 fillings (75.24%) and as good in 26 (24.76%). In category C, the precision of preparation was found to be very good in 88 fillings (83.81%) and good in 17 cases (16.19%).

Table 3. Evaluation of handling properties of the Filtek Supreme material immediately after insertion

		Evaluation								Total	
		very good		good		quite good		negative			
		n	%	n	%	n	%	n	%	n	%
A	Insertion, wall adhesion, condensation	93	88.57	12	11.43	0	-	0	-	105	100
B	Surface modelling in the non-polymerized material	79	75.24	26	24.76	0	-	0	-	105	100
C	Accurate handling (excess removal, finishing and polishing)	88	83.81	17	16.19	0	-	0	-	105	100
D	Shade selection (difficulties, time, transparency)	29	27.62	67	63.8	9	-	0	-	105	100

Some difficulties were observed in shade selection (D): 9 fillings were evaluated as quite good (8.58%), 67 as good (63.8%) and 29 as very good (27.62%). The lower percentage of very good results in this category resulted from the incomplete range of shades in our set, which increased the difficulties in achieving the expected cosmetic effects and lengthened the working time.

Immediately after the procedures all the fillings were assessed as ideal – 0 according to all Ryge's scale parameters.

Table 4. Clinical evaluation of Filtek Supreme fillings after 12 months according to the Ryge's scale

Scores	Surface of fillings		Anatomical shape		Marginal adhesion	
	number of teeth	percentage	number of teeth	percentage	number of teeth	percentage
0	88	100	88	100	83	94.32
1	0	-	0	-	5	5.68
2	0	-	0	-	0	-
3	0	-	0	-	0	-

The results of clinical evaluation of fillings after 12 months are presented in Table 4. The filling surface, finish, polish and anatomical shapes remained ideal – 0 in 100% of fillings. The ideal marginal adhesion was assessed as 0 in 94.32%; in the remaining 5.69% of fillings the score was 1 (in 5 teeth the discolorations at the enamel-filling border were observed). None of the fillings was assessed as 2 or 3. Moreover, secondary dental caries was not demonstrated.

DISCUSSION

Filtek Supreme represents the group of composites in which the innovative nanotechnology was used. The essence of its structure is an extremely small particle (5–75 nm) which is an independent filler as well as a component of bigger structures – nanoclusters corresponding to macroparticles in

traditional composites. The filler amount in the nanocomposite reaches 78.5%. The Filtek Supreme structure resembles hybrid materials and therefore, the results of the study were compared with the available data concerning fillings with hybrid and other composite materials evaluated over similar periods of time.

The handling properties of Filtek Supreme were found to be high. Easy insertion and adhesion to tooth tissues without sticking to standard dental instruments facilitate the preparation. A relatively hard consistency of the material provides good conditions for precise reconstruction of the anatomical shape of surfaces. The effect achieved does not change until light polymerization. This fact is extremely important while reconstructing the contact point in II, III and IV class cavities (according to Black). The next stage – preparation of the filling and its polishing – was also evaluated by dentists as high and the effect obtained in the majority of cases may be compared to glass polish.

Similar results were obtained in the questionnaire study carried out among 400 dentists from various European countries evaluating the handling properties of Filtek Supreme (9). The available literature lacks any studies performed after 12-month clinical observation of nanocomposite fillings. The present results may be compared with the studies of other authors assessing Filtek Supreme over a shorter period of time (2, 11). Our observations about clinical features are comparable with the results reported by Ernst after a 6-month observation period (2) and by Skałecka-Sądel et al. (3 months of observation) (11). In the individual categories the top scores were given to: the filling surface and anatomical shape – 100% and 98%, marginal adhesion – 96.08% and 100%, respectively (2, 11).

The microhybrid Tetric (5) fillings evaluated 12 months after the insertion were given the highest scores in 98.0% of cases in relation to their anatomical shape and colour and in 95.9% as to marginal adhesion; the surface structure, finish and gloss were found to be ideal in 87.8% of cases.

The 12-month evaluation of the hybrid material – Herculite XR and Valux Plus showed the ideal anatomical shape and surface finish of 100% of fillings with both these materials; in 85% of Herculite XR and 90% of Valux Plus fillings the marginal adhesion was very good (6).

The evaluation of the individual clinical features of Filtek Supreme, i.e. marginal adhesion, anatomical shape and surface of fillings, revealed that the most common changes were observed in marginal adhesion. This observation is consistent with the findings of other authors who carried out clinical studies about composite fillings (2, 3, 5). In order to increase the bond strength to the hard dental tissues the studies are being carried out to improve the adhesive systems (12) and physical properties of composite materials.

In the present study, all fillings were inserted using the self-etch bonding system Adper Promet L-Pop. One of the advantages of self-etch systems is their substantially shorter working time, lower risks of improper use or error, which cannot be always avoided while using multi-component systems (7, 12).

The failures in marginal adhesion of fillings with the use of self-etch bonding systems are likely to result from worse enamel etching which does not provide as strong microretension as the one observed in traditional etching with 37% phosphorous acid (4, 6).

Jodłowska et al. in their *in vitro* study evaluated the marginal tightness of Filtek Supreme fillings with the bonding system Adper Prompt L-Pop using the stain penetration test. It was demonstrated that 87% of fillings were fully acceptable (6). The 12-month clinical observation of Adper Promet L-Pop used with Dyract AP, Hytec or Reference materials revealed marginal discolorations in 2.5%–7.0% of cases and lack of marginal tightness in 4.0%–12.0% of fillings (4, 8). Slight differences in the results obtained are likely to result from the differences in physical properties of the composite materials used and the way of preparation of hard dental tissues.

The mechanical properties of materials also depend on the type of lamps used for polymerization. Bachanek et al. (1) carried out the extra-oral evaluation of the selected resistance properties of Filtek

P-60 and Filtek Z-250 (3M) polymerized with the halogen and plasma lamps. The 3M materials cured with the plasma lamp showed higher hardness, lower wear and higher resistance to trauma.

After 12 months of observation of Filtek Supreme fillings no cases of secondary dental caries were found and the retention of the composite material was 100%.

CONCLUSIONS

1. The findings concerning the handling properties of the Filtek Supreme composite are satisfactory.

2. The one-year clinical observation demonstrates that Filtek Supreme is a durable restorative material. However, complete evaluation of its usefulness requires further clinical studies covering the periods of several years.

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SUMMARY

The aim of the study was to evaluate the handling and clinical properties of 3M ESPE Filtek Supreme universal restorative after 12 months of observation. The study included 105 fillings. The following handling properties were examined: the simplicity of insertion, adhesion to the cavity walls during condensation, surface modelling, finishing and polishing as well as shade selection. According to all the criteria taken into account, the majority of fillings were found to be very good and good. The clinical examination carried out after 12 months included 88 fillings. The four-point Ryge's scale was used. The surface finish and anatomical shape were excellent in 100% of cases. The ideal marginal adhesion was observed in 95.32% of fillings. After 12 months 100% of fillings were clinically acceptable.

Filtek supreme – cechy użytkowe i kliniczne kompozytu nanofilowego po 12 miesiącach obserwacji

Celem pracy była ocena cech użytkowych oraz cech klinicznych uniwersalnego kompozytu Filtek Supreme firmy 3M ESPE po 12 miesiącach. Ocenie poddano 105 wypełnień, oceniając: łatwość wprowadzania materiału do ubytku, przyleganie do ścian w czasie kondensacji w ubytku, modelowanie powierzchni, opracowywanie, polerowanie, dobór barwy. Wypełnienia otrzymały w przeważającej większości noty bardzo dobre i dobre we wszystkich ocenianych kryteriach. Badanie kliniczne wykonane po 12 miesiącach objęło 88 wypełnień. Zastosowano czterostopniową skalę Ryge'a. Gładkość powierzchni i kształt anatomiczny w 100% uzyskał najwyższą ocenę. Idealne przyleganie brzeżne dotyczyło 95,32% wypełnień. Po upływie 12 miesięcy 100% wypełnień było akceptowalnych klinicznie.