

Wear properties of flowable composites by two-body sliding abrasion test

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Introduction

Resin composites in dentistry have shown continuous improvements of properties. Still, restorative composites may be susceptible to wear in the mouth. Flowable composites were even more susceptible to wear in the oral cavity, but newer formulations have improved significantly, contributing to better performance in clinical treatment.

The objective of this study is to compare the wear and surface properties of flowable composites after in vitro two-body sliding abrasion.

Materials & Methods

Flowable composites tested included 1. NovaPro Flow (Nanovna Biomaterials), 2. SureFil SDR Flow (Dentsply), 3. Filtek Supreme Ultra Flowable Restorative (3M ESPE), 4. Dentex Flow (Dentex Dental Materials), and 5. G-aenial Universal Flo (GC). All flowable composites were injected into aluminum rectangular molds (5 x 20 x 1.5 mm) that were made to fit the abrasive machine. All specimens (N=45) were covered by Mylar strips and light cured by Bluephase 16i (Ivoclar Vivadent). The molds with cured composite specimens were then mounted in a sliding abrasion tester. The antagonist material used was Vita Mark II. Sliding abrasion with a length of 15 mm and a constant vertical load of 2N (wear stress ~0.2 MPa) was performed on the composites for 50,000 strokes under water flow (1L/hr).

Wear depth was measured by a digital micrometer gauge (Mitutoyo ID-F150) with an accuracy of 0.001 mm. The unmodified surface around the wear area was used as the reference for depth of the groove. Surface roughness was measured on all wear grooves and intact composite surfaces by a profilometer (Mitutoyo SJ-201). Data were analyzed via One-Way ANOVA using JMP 12. The Au/Pd coated specimens were examined under a field emission scanning electron microscope (FESEM, SU6600, Hitachi, Tokyo, Japan) at 15 kV.



Fig.1 Flowable Composite Materials tested



Fig.2 Apparatus for two-body sliding abrasion test

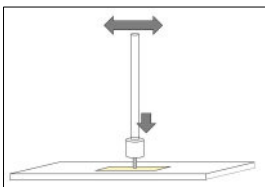


Fig.3 Schematic for two-body sliding abrasion test

Results

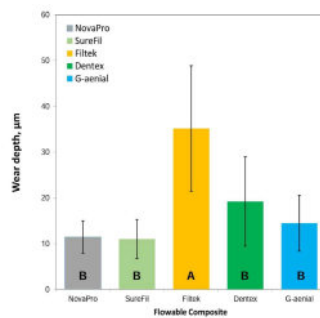


Fig. 4 Composite wear depth (μm) of different flowable composites after wear test. Levels not connected by same letter are significantly different ($p < 0.05$).

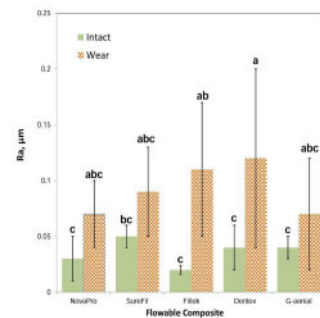


Fig. 5 Composite surface roughness R_a (μm) of different flowable composites after wear test. Levels not connected by same letter are significantly different ($p < 0.05$).

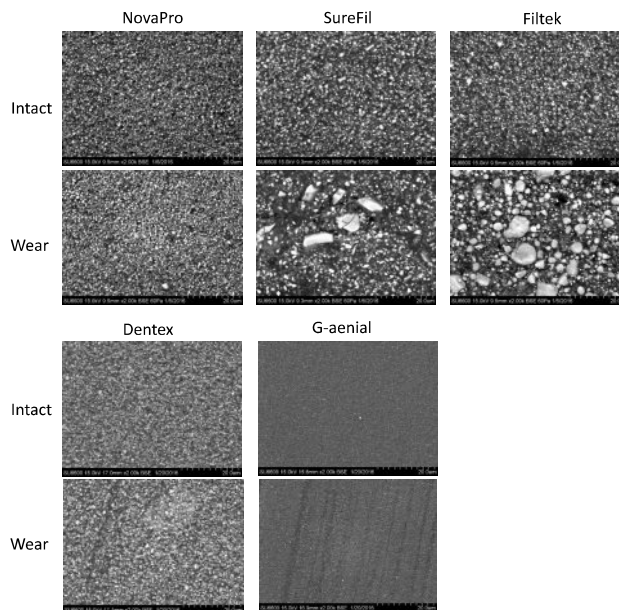


Fig.6 SEM backscattering micrographs of the flowable composite non-polished surfaces with and without wear.

Figure 4 shows the wear depth on the wearing test. In the present study, the wear depth of Filtek was significantly deeper compared with other flowable composites.

Figure 5 shows the influence of surface roughness of the flowable composite. Surface roughness was more marked in SureFil compared with other materials in the intact area. In contrast, the surface roughness of Filtek, which showed the deepest wear depth, was the least marked. Surface roughness of the area that had been worn down after the wearing test increased in all flowable composites. A significant difference was observed in the surface roughness of each sample: Dentex, Filtek, SuleFil, NovaPro, and G-aenial in a descending order.

Conclusions

Within the limitations of this study, the following conclusions were drawn: Surface roughness significantly increased after the wear test in all groups. There were significant differences of wear depth among the different types of flowable composites tested, however, the differences may not be clinically relevant.