VOCO – FINAL REPORT

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EVALUATION OF MICROHARDNESS AND WEAR AFTER BRUSHING OF DIRECT AND INDIRECT CAD/CAM COMPOSITES

1 OBJECTIVE

The aim of this study was to evaluate the surface microhardness and wear after brushing of different direct light-cured composites versus indirect pre-cured composite CAD/CAM blocs after toothbrushing.

2 METHODS

2.1 Specimens preparation

One hundred and sixty composite samples were prepared using one of the following direct or indirect materials (n=20):

- **Grandio SO** (Voco) – DIRECT nanohybrid light-cured composite with filler content of 89% w/w.
- **Grandio Blocs (Voco)** – INDIRECT nanohybrid pre-cured composite blocs with filler content of 86% w/w.
- **Z350 XT** (3M/Espe) – DIRECT nanoparticle light-cured composite with filler content of 72.5% w/w.
- **Lava ultimate** (3M/Espe) - INDIRECT nanoparticle pre-cured composite blocs with filler content of 80% w/w.
- **Kalore** (GC) – DIRECT nanohybrid light-cured composite with filler content of 82% w/w.
- **Cerasmart** (GC) – INDIRECT nanohybrid pre-cured composite blocs with filler content of 71% w/w.
- **Opallis (FGM) -** DIRECT nanohybrid light-cured composite with a filler content of 78,5 to 79,8% w/w.
- **Brava (FGM)** – INDIRECT nanohybrid pre-cured composite blocs with filler content of 72% to 82% w/w.

For the indirect composite blocs, cylinders with 6mm of diameter were obtained using a diamond trephine mill. All blocks were color A2 and HT. Transverse cuts were performed using a diamond disc in a precision cutting machine (Labcut, Extec), resulting in composite cylinders of 2mm thick. A lateral groove on each sample was created in order to allow the perfect repositioning for the profilometry reading. An impression of these samples was made using a silicone impression material (Express, 3M), in order to create a mold as a matrix for preparing identical direct composite samples.

The direct composites were applied inside the silicone matrix in a single increment. In order to produce a flat surface, a Mylar strip was positioned over the composite and over it a microscope glass slide was pressed. The glass slide was removed and the light curing was performed through the Mylar using a LED light curing unit (Elipar Freelight 2 - 3M/Espe), with an irradiance of 1000mW/cm^2 for 40 s, with light probe touching the surface. The bottom side of each specimen was identified with a scratch made with a scalpel blade. The specimens were stored in ultrapure water for 24 hours to allow the complete post-cure of the composite.

The surface of direct and indirect composite specimen was polished with P1200, P2400 and P4000 SiC sandpaper (Extec, Enfield, CT, USA) in a polishing device (Panambra, São Paulo, SP, Brazil). In between each sandpaper the samples were cleaned in an ultrasonic bath for 10 min.

2.2 Microhardness evaluation

The surface microhardness of all samples was evaluated using a knoop microhardness tester (FM-700, Future-Tech, Tokyo, Japan), with a load of 50 g for 10 s. Three indentations were performed for each sample and the mean was calculated.

2.3 Abrasion test

At the baseline the specimens were evaluated in a profilometer in order to obtain the initial surface profile (Ra). After that, the top surface of each composite cylinder was submitted to 100,000 brushing cycles under a load of 200 g, in order to simulate the clinical service, following the rules of ISO/TR 14569-1:2007. Slurry of a regular toothpaste (Colgate Total 12, Colgate-Palmolive, São Bernardo do Campo, SP) e and artificial saliva, in a ratio of 1:2 by weight was prepared. After brushing the samples were washed and analyzed again in the profilometer. The final profiles were superimposed to the baseline ones, making possible to measure the wear in microns.

3 RESULTS

3.1 Microhardness

The results of one-way ANOVA for microhardness showed significant differences among the groups (p=0.0001). The results of Tukey´s test for the comparisons are shown in Table 1. I can be seen that for the indirect materials, Grandio Blocs presented the highest microhardness values. Lava showed higher microhardness than Brava and Cerasmart. For direct composites, GrandioSO showed higher microhardness than all the other materials. Z350 showed higher values than Kalore and Opallis.

Table 2 – Results of Tukey´s test for microhardness of direct and indirect (in red letters) composites.

Composite	Mean (Mpa)	SD	Homogeneous sets*				
Kalore	61.21	4.02	A				
Opallis	65.17	3.02	A	B			
Brava	66.90	5.08	A	B			
Cerasmart	69.28	5.17		B			
Z350	83.59	5.24			C		
Lava	113.74	8.09				D	
GrandioSO	116.09	8.33				D	
Grandio Blocs	130.10	12.36					E

* Groups followed by the same letters do no present significant differences.

The Figure 1 shows the means of microhardness for all direct and indirect materials according to the manufacturer. In can be observed that the indirect materials showed higher microharness than the respective direct ones.

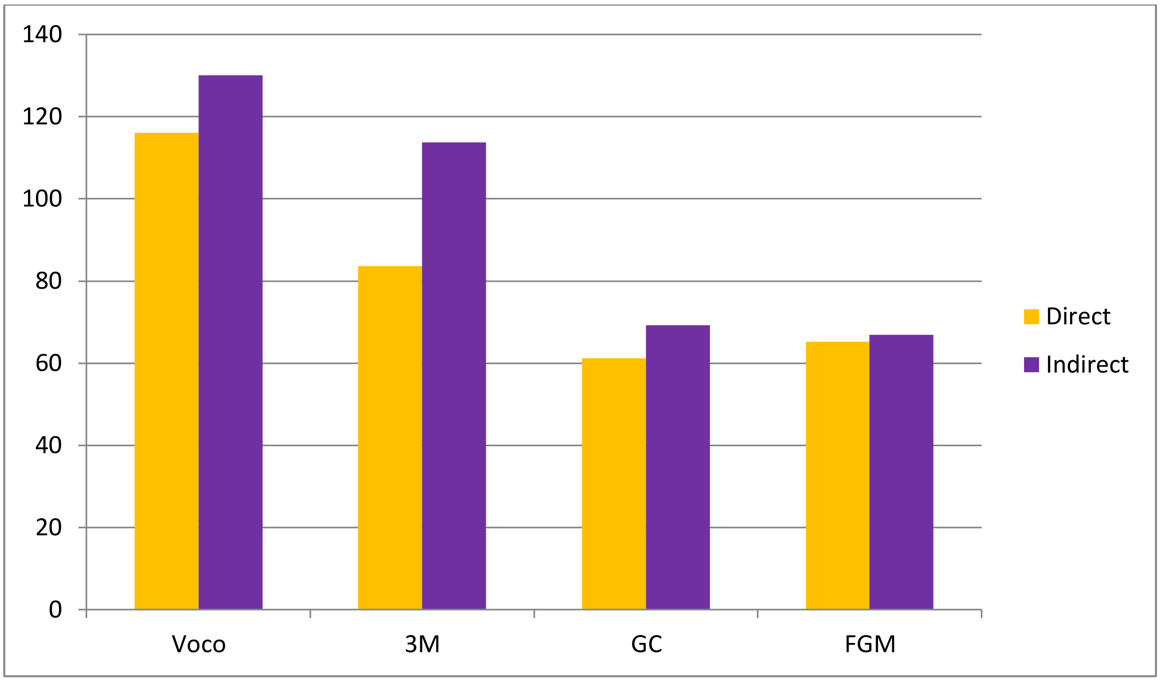

Figure 1 – Means of Knoop microhardness according to the manufacturer for direct and indirect materials.

3.2 Wear

The results of one-way ANOVA for wear showed significant differences among the groups (p=0.0001). The results of Tukey´s test for the comparisons are shown in Table 2. I can be seen that for the indirect materials, Grandio Blocs and Lava presented the smaller wear values. Cerasmart showed higher wear than Grandio Blocs and Lava but less than Brava. For direct composites, GrandioSO and Z350 showed less wear than all the other materials. Opalis and Kalore showed higher wear values.

Table 2 – Results of Tukey´s test for wear (µm) of direct and indirect (in red letter) composites.

Composite	Mean (Mpa)	SD	Homogeneous sets*				
Grandio Blocs	6.41	2.44	A				
GrandioSO	8.86	2.46	A	B			
Lava	10.77	2.65	A	B			
Z350	11.42	2.72		B			
Cerasmart	17.14	2.93			C		
Opallis	28.94	8.99				D	
Kalore	31.78	6.38				D	
Brava	47.11	7.61					E

* Groups followed by the same letters do no present significant differences.

The Figure 1 shows the means of wear for all direct and indirect materials, according to the manufacturer. In can be observed that for Voco, 3M and GC, the indirect materials showed less wear values than the direct ones. However, for FGM manufacturer, the indirect composite more wear than the direct one.

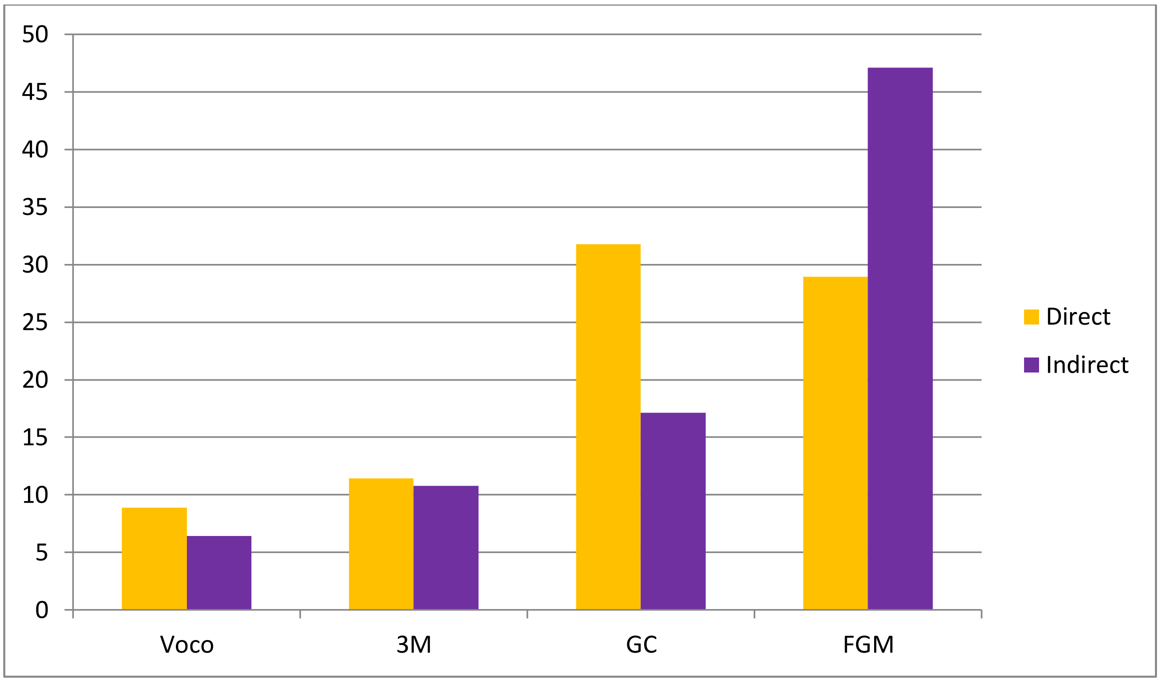

Figure 1 – Means of wear (µm) according to the manufacturer for direct and indirect materials.

4 Conclusions

- The indirect materials showed higher microhardness than the direct ones.
- Grandio Blocs presented higher microhardness values than all materials tested.
- GrandioSO showed higher microhardness than all the other direct composites tested.
- Grandio Blocs and Lava ultimate showed less wear than the other indirect composites tested;
- GrandioSO and Z350 showed less wear the other direct composites tested.
- Brava showed more wear the all the other materials tested.