Simulated Nighttime Grinding of 3D Printed Night Guards vs Lab Manufactured Night Guards

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INTRODUCTION

Bruxism is a common condition that entails grinding of the teeth or clenching of the jaw. This parafunctional habit contributes to dental attrition, as well as temporomandibular disorders (TMD). Among treatment options, night guards are the most common therapeutic procedures . These appliances are conventionally fabricated with polyethylene (PVAc-PE), acrylic resin, or polymethylmethacrylate (PMMA) by an analog workflow including refractory cast. Now these appliances can be fabricated using a (complete) digital workflow, applying subtractive as well as additive CAD/CAM methods.
However, evidence of resistance to wear of these new 3D printed materials compared to conventional plastic night guards is scarce.

OBJECTIVE

To compare the wear of two different 3D printed resins and a lab manufactured night guard.

METHODS

Tested materials were divided into 3 groups of 10 specimens, each measuring 10x10x10 mm:

Group 1 - Sprint Ray Night Guard Flex (Sprint Ray, Los Angeles, CA)
Group 2 - Sprint Ray Night Guard Firm (Sprint Ray, Los Angeles, CA)
Group 3 - Clear Splint Biocryl (Great Lakes Orthodontic, Tonawanda, NY)

Wear measurement

Surface roughness was measured before and after the wear test using the profilometer Roughness Tester PCE-RT 1200 (PCE Instruments) and a 3D laser profilometry TMS-500 Top Map Pro.Surf (Polytec GmbH, Germany).

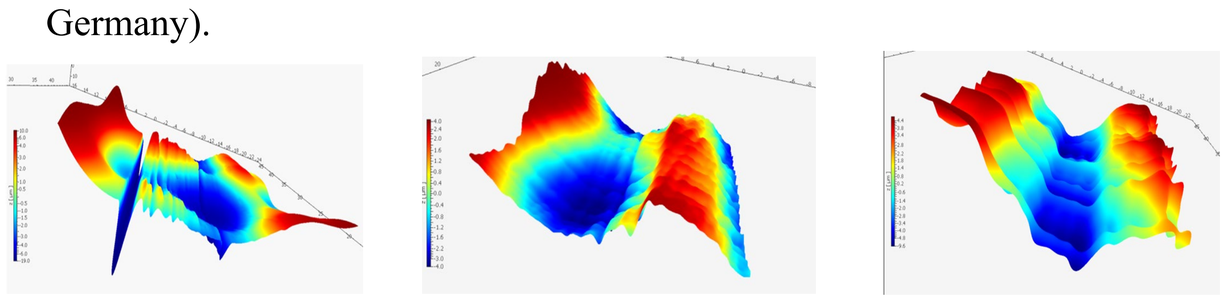

Figure 1: Optical profilometry image showing 3D surface topography of NGP, Firm and Flex resin, respectively, after wear test.

Antagonist Enamel

Enamel antagonists (molars cusps) were prepared from caries-free extracted molars. Four cusps were collected from each tooth. Standardization of the enamel antagonists for shape and size was done by using a diamond bur and high-speed handpiece under water irrigation. Schematic representation of preparing antagonist enamel is show in Figure 2.

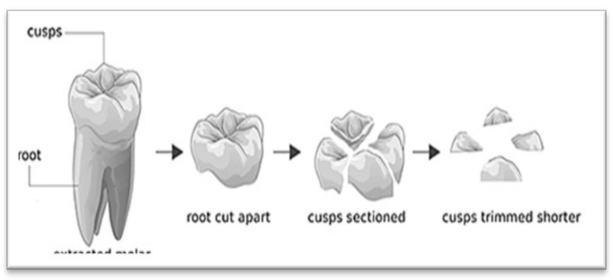

Figure 2 : Schematic representation of antagonist enamel preparation. [1]

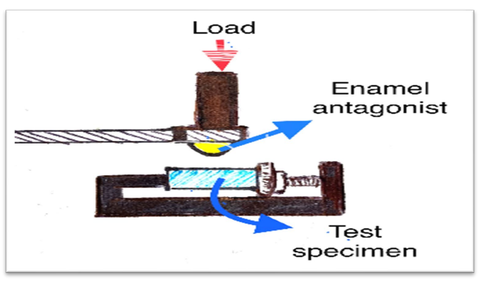

Figure 3: Schematic representation of enamel antagonist and opposing splint resin material mounted on the wear simulator

Wear test

The wear test was performed using a wear simulator developed by the Tufts University School of Engineering. The antagonists (enamel molar cusps) ran back and forth 8mm (average lateral excursion in the bruxism group) for 20,000 cycles to resemble one month of clinical performance, assuming total grinding time of 320 seconds/night (40 seconds per hour of sleep/average 8 hours of sleep/night) under a load of 25 N. Specimen and antagonists were lubricated with water which was dispensed regularly throughout the test.

RESULTS

Flex and Firm showed more resistance to wear than NGP. There was no statically significant difference between Firm and Flex groups. Descriptive statistics were calculated for wear, the NGP group showed the highest wear, in both profilometry analysis, with a mean ± SD of -0.94±0.55 for the stylus and with a mean ± SD of -0.92±0.90 for the Laser 3D analysis . There was no statistically significant difference between the Firm and Flex groups (p=0.612, stylus) and (p=0.443 laser).

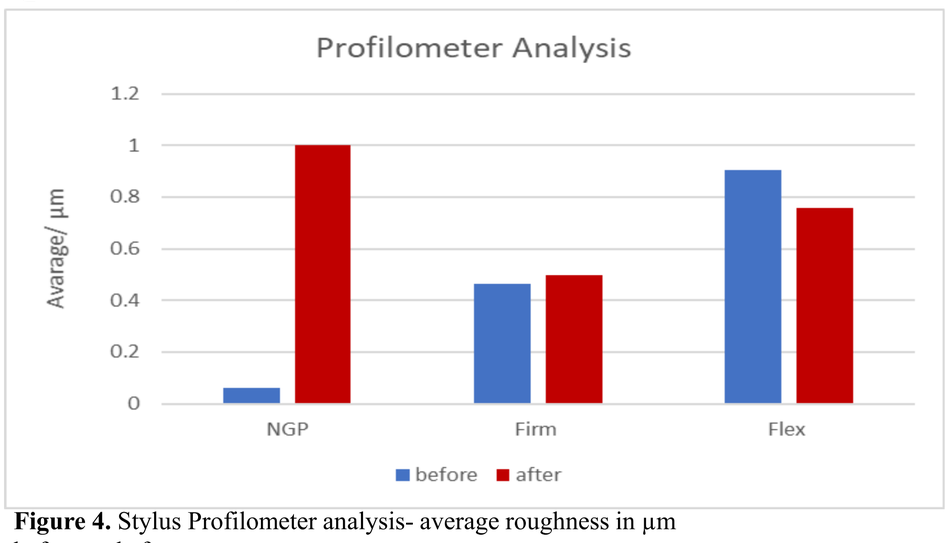

Figure 4. Stylus Profilometer analysis- average roughness in µm before and after wear.

GROUP		MEAN ± SD	P-VALUE*
FIRM (n=10)	BEFORE	0.462 ± 0.074	<0.0001
	AFTER	0.499 ± 0.101	
FLEX (n=10)	BEFORE	0.904 ± 0.567	
	AFTER	0.758 ± 0.438	
NGP (n=10)	BEFORE	0.061 ± 0.015	
	AFTER	1.001 ± 0.541	

Table 1. Stylus profilometer analysis before and after wear test.

GROUP		MEAN ± SD	P-VALUE*
FIRM (n=10)	BEFORE	0.507 ± 0.104	<0.0001
	AFTER	0.517 ± 0.118	
FLEX (n=10)	BEFORE	0.489 ± 0.204	
	AFTER	0.565 ± 0.120	
NGP (n=10)	BEFORE	0.371 ± 0.333	
	AFTER	1.295 ± 0.572	

Table 2. Laser profilometer analysis before and after wear test.

CONCLUSIONS

Under these in vitro study conditions, Flex and Firm showed more resistance to wear than NGP. There was no statistically significant difference between Firm and Flex groups.

REFERENCES

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2. Dunn DB, Lewis MB. CAD/CAM occlusal splints: a new paradigm. Aust Dent Pract. 2011;22:130–4.

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