
ORIGINAL ARTICLES

Reproducibility of the Newly Developed Dental Prescale II System and Bite Force Analyzer for Occlusal Measurements

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We examined the reproducibility of measurement values obtained using the recently released Dental Prescale II system (50H, GC) and analysis software (Bite Force Analyzer, GC).

One adult male volunteer with normal occlusion was asked to bite down for 3 s with the Prescale II in situ to produce the sample. Occlusal contact area, mean occlusal pressure, and occlusal force were measured. The measurements were then analyzed 5 times each under the following conditions: 1) with the sample placed on the scanner (reference condition); 2) after removing and then replacing the sample on the scanner (repositioned); 3) after automated trimming (adjusted); 4) after manual trimming on the screen (manually adjusted); and 5) after the sample was stored for 2 days indoors (day 2) or 3 days indoors (day 3). Statistical analysis was performed using one-way analysis of variance with Bonferroni post hoc analysis. The coefficient of variation (CV) was also determined.

Measurement values for occlusal contact area were significantly lower under the reference condition than under the repositioned, adjusted, manually adjusted, and day 3 conditions. Mean occlusal pressure was significantly higher under all conditions compared with the reference condition. Occlusal force was significantly lower under the repositioned, adjusted, and manually adjusted conditions compared with the reference condition but was significantly higher under the day 2 condition. CV values were 0.71–4.48 for occlusal contact area, 0.46–1.23 for mean occlusal pressure, and 0.28–1.05 for occlusal force. These results indicate high reliability of the Dental Prescale II system and occlusal force analysis software.

Key words : Dental Prescale II, analysis software, reliability, occlusion

Introduction

The Dental Prescale system is an excellent device for visualizing occlusal contact¹⁾, and reproducibility of measured values obtained with the device and a dedicated analyzer is reported to be high²⁻⁴⁾. The new Dental Prescale II system and analysis software were recently released⁵⁾, but its reproducibility in clinical practice is unclear as yet. Here, we report the reproducibility of occlusal measurements obtained with the latest version of the device and software.

Materials and Methods

In this study we used the Dental Prescale II 50H

(GC Corp., Tokyo, Japan), a dedicated scanner (GT-X830, EPSON, Tokyo, Japan), and analysis software (Bite Force Analyzer, GC Corp.) (Fig. 1). One adult male volunteer with normal occlusion was asked to bite for 3 s with the Prescale II *in situ* to produce the sample. Analysis was performed after calibration, and manual trimming of the sample on the display screen and cleaning of artifacts was carried out according to the manufacturer's instructions.

Occlusal contact area, mean occlusal pressure, and occlusal force were measured. The measurements were then analyzed 5 times each under the following conditions: 1) with the sample placed on the scanner (reference condition); 2) after removing and then

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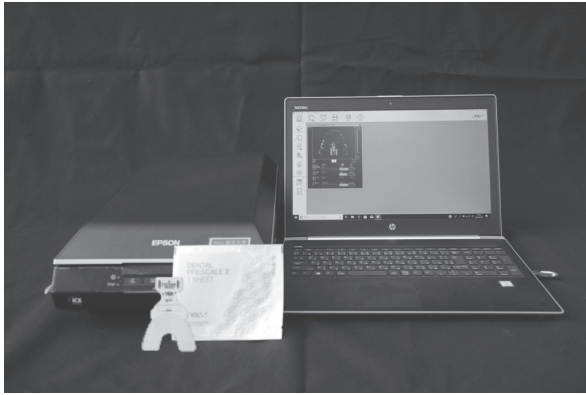


Fig. 1 Dental Prescale II, scanner, and personal computer with the bite force analyzer software installed.

replacing the sample on the scanner (repositioned); 3) after automated trimming (adjusted); 4) after manual trimming on the screen (manually adjusted); and 5) after the sample was stored for 2 days indoors (day 2) or 3 days indoors (day 3).

Because maximum occlusal pressure was 120 MPa in all instances, the measured values for occlusal contact area, mean occlusal pressure, and occlusal force were used. Statistical analysis was performed using one-way analysis of variance with Bonferroni *post hoc* analysis (Excel statistical analysis 2012, SSRI Co., Ltd., Tokyo, Japan). Significance level was set at 5%. The coefficient of variation (CV) was also calculated.

The study protocol was approved by the Ethics Committee of Asahi University School of Dentistry (Approval No. 30039).

Results

Measurement values for occlusal contact area were significantly lower under the reference condition than under the repositioned, adjusted, manually adjusted, and day 3 conditions (Fig. 2). Mean occlusal pressure was significantly higher under all conditions compared with the reference condition (Fig. 3). Occlusal force was significantly lower under the repositioned, adjusted, and manually adjusted conditions compared with the reference condition but was significantly higher under the day 2 condition (Fig. 4).

The CV values were 0.71-4.48 for the occlusal contact area, 0.46-1.23 for mean occlusal pressure, and 0.28-1.05 for occlusal force; variation was minimal under all analysis conditions (Table 1).

Discussion

The measurement range of the Dental Prescale II is almost the same as that of the earlier Dental Prescale system, with thickness ranging from 100 μ m to 150 μ m. As yet, no obvious differences have been reported between the two Dental Prescale systems in terms of occlusal contact area and bite force at any point⁵⁾. However, because measurements are obtained under various conditions in the clinical setting, we conducted this study to determine the reproducibility of measurements.

Significant differences were observed in the values

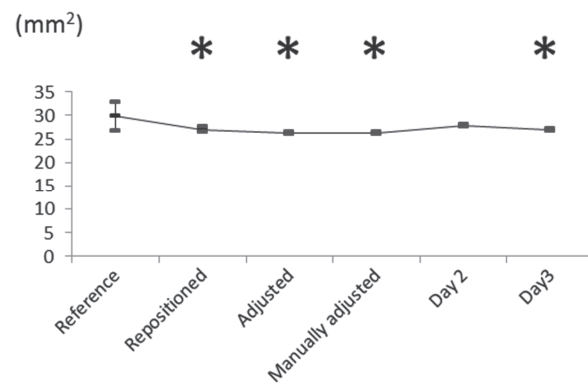


Fig. 2 Occlusal contact area under each experimental condition

*: Significant difference compared with the reference condition ($p < 0.05$)

Measurement values for occlusal contact area were significantly lower under the reference condition than under the repositioned, adjusted, manually adjusted, and day 3 conditions.

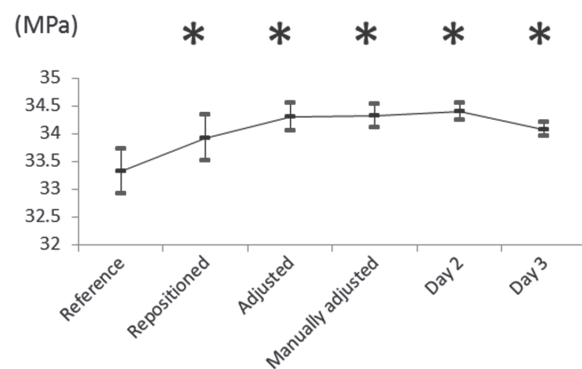


Fig. 3 Mean occlusal pressure under each experimental condition

*: Significant difference compared with the reference condition ($p < 0.05$)

Mean occlusal pressure was significantly higher under all conditions compared with the reference condition.

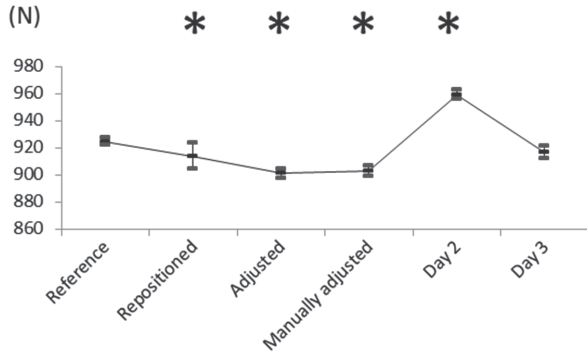


Fig.4 Occlusal force under each experimental condition
 *: Significant difference compared with the reference condition ($p < 0.05$)

Occlusal force was significantly lower under the repositioned, adjusted, and manually adjusted conditions compared with the reference condition but was significantly higher under the day 2 condition.

for occlusal area, mean occlusal pressure, and occlusal force between the various measurement conditions examined in this study. Similar results were obtained in the previous Dental Prescale system^{2, 3}. Our findings do not indicate which measurement condition is optimal, but considering the large difference in occlusal force measured on day 2 of storage at room

temperature, obtain measurements under fixed conditions is preferable. For example, on the day the sample is obtained, measurements should be taken after manual trimming on the display screen and cleaning to remove artifacts.

The CV values were low under all conditions in this study. For example, the CV for manual trimming was lower than that obtained with the previous version of the system (Table 2). Therefore, we conclude that the measured values are stable and reproducible. In addition, although we did not conduct this study to investigate measurement error during repeated measurements with the new Dental Prescale II, we do not anticipate a problem in using the device clinically with individual patients. Also, because the CV values were small between the reference and repositioning conditions, when we use the device in the clinical setting, analyzing 1 sample just once may be sufficient.

According to the manufacturer, the Dental Prescale II has a thicker pressure-sensitive sheet than the conventional Dental Prescale, so the colored area is increased by applying pressure to a wider area of occlusal proximity; the occlusal force value

Table 1 Coefficient of variation (CV) for occlusal contact area, mean occlusal pressure and occlusal force under each experimental condition

Condition	occlusal contact area	mean occlusal pressure	occlusal force
Reference	4.48	1.23	0.28
Repositioned	2.11	1.22	1.05
Adjusted	0.87	0.71	0.39
Manually adjusted	1.02	0.63	0.42
Day 2	0.78	0.46	0.35
Day 3	0.71	0.38	0.52

Table 2 Comparison of coefficient of variation (CV) values between our report and other reports

Reporter	Measurement condition	n	Occlusal contact area	Mean pressure	Occlusal force
Ogata et al.(1994)	Multiple measurement of same sheet	63	3	1	2.4
Kim et al.(1994)	Measurement of five sheets	5	11.1		14.2
Adachi et al.(2019)	Five measurement of one sheet	1	1.02	0.63	0.42

will also be high⁹⁾. This means it is not possible to compare the measurements obtained with the new Dental Prescale II and the conventional Dental Prescale.

Conclusion

Under the same measurement conditions, the reproducibility of the measurement values obtained with the Dental Prescale II and occlusal force analysis software is high.

Conflict of interests

The authors have no conflict of interest to disclose regarding this study.

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