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# An *in vitro* Evaluation of Commercially Available Disposable Prophylaxis Angles

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# An In Vitro Evaluation of Commercially Available Disposable Prophylaxis Angles

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## Abstract

Although a number of manufacturers are marketing disposable prophylaxis angles, no literature exists regarding the mechanical efficacy and efficiency of these products. It was the purpose of this in vitro evaluation to compare and evaluate five brands of commercially available disposable prophylaxis angles for vibration, noise, heat rise, and torque. Random samples of each brand of disposable prophylaxis angle were utilized. Vibration was measured with a height gauge and running motor; noise was measured with a sound meter and heat rise was measured from 68°F on the head and body of the disposable prophylaxis angles, and torque required to destroy the gear was measured with a torque gauge. Means, standards deviations, standard errors, and coefficients of variation were computed for each of the variables tested. Results revealed that four of the brands tested (in alphabetical order) perform reliably when considering vibration, noise, heat rise, and torque: Denticator, Teledyne Getz, and Young Dental. The Ash/Dentsply had significant heat rise in the head and body. Both the Ash/Dentsply and Brahler disposable prophylaxis angles demonstrated significant vibration.

## Introduction

In recent years there has been widespread concern over infection control in the oral healthcare environment. This concern was further enhanced when the Occupational Safety and Health Administration and Centers for Disease Control proposed guidelines for infection control practices in dentistry.[1-5]

Concomitant with the proposal of infection control practices for the dental profession, dental manufacturers responded with materials and equipment that would assist oral healthcare professionals in meeting infection control guidelines. One particular product that has been marketed as a portion of the infection control armamentarium is the disposable prophylaxis angle. To date, no information exists in the literature regarding the mechanical efficacy and efficiency of these disposable prophylaxis angles.

Currently, there are several well-known manufacturers of disposable prophylaxis angles: Brahler, Denticator, Ash/Dentsply, Teledyne Getz, and Young Dental Mfg. Co. It was the purpose of this in vitro evaluation to compare these brands of commercially available disposable prophylaxis angles for vibration, noise, heat rise, and torque.

## Acknowledgment

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## Methods and Materials

Fifty samples of each brand of commercially available disposable prophylaxis angles were randomly selected from packages of the disposable prophylaxis angles as they were received from the manufacturers. Ten samples of each brand of disposable prophylaxis angle were used for each of the following tests: vibration, noise, heat rise, torque test 1 (amount required to turn the rubber cup), and torque test 2 (amount required to destroy the gear).

The disposable prophylaxis angles were tested for vibration utilizing a Stroboscope (Electric Brazing Co., Montclair, NJ), a test indicator (Mitutyo, Paramus, NJ), a height gauge (Mitutyo, Paramus, NJ), and a running motor (Young Dental Manufacturing, Earth City, MO). Each disposable prophylaxis angle sample was placed on the running motor (which conformed to the International Standard Organization's standard for dental nosecones) to simulate a handpiece. The Stroboscope was utilized to verify that the running motor was set at 1,250 rpm. The test indicator, which was held in place by the height gauge, measured the distance of movement (vibration) of the disposable prophylaxis angles in mils (1 mil=.0001 inch). All testing for vibration was conducted on a calibrated granite surface plate (Continental Granite Corp., Escondido, CA) that was flat with a repeat measurement accuracy of .000060 inches. Ten samples of each brand of disposable prophylaxis angle were attached to the running motor and readings were taken from the test indicator as to the distance each disposable angle moved. Each disposable prophylaxis angle was run for two minutes, and the greatest movement during that time was recorded.

The test for noise, which was conducted in a sound-controlled room, also utilized the running motor to simulate a dental handpiece. The running motor was once again set at 1,250 rpm, verified with the Stroboscope. Each of the disposable prophylaxis angles was attached to the running motor and a Realistic sound level meter (Korea) was held at a constant 1/2-inch from the head of each angle to record the noise level created by the disposable prophylaxis angle. Each disposable prophylaxis angle was run for two minutes, and the reading was taken at the end of the two-minute cycle. The noise made by the running motor was subtracted from each reading.

The test for heat rise complied with the protocol of Military Specification 4.44 (MILH-H-36809B).[6] Each of the 10 samples of the disposable prophylaxis angles was attached to the running motor, which was set at 1,500 rpm, verified with the Stroboscope. Subsequently, heat sensors were connected to the head of prophylaxis angle and to the body of the prophylaxis angle. A four-ounce load was placed against the rubber cup to provide resistance. The test was performed in a temperature-controlled room that was kept at a constant 68°F. Each angle was run for three minutes, and at the end of the three-minute cycle, the temperature rise from 68°F was recorded.

**Table I**

**Comparison based on vibration.**

| Brand | SNK* | Mean (std) |
|---|---|---|
| Ash/Dentsply | | 1.01 (0.33) mils |
| Brahler | | 0.81 (0.64) mils |
| Denticator | | 0.39 (0.36) mils |
| Teledyne Getz | | 0.35 (0.24) mils |
| Young Dental (white cup) | | 0.22 (0.09) mils |
| Young Dental (gray cup) | | 0.14 (0.06) mils |

*Student-Newman-Keuls Multiple Comparison Test
One-way ANOVA, $p$=.0024
One mil=($10^{-3}$ inches)

**Table II**

**Comparison based on noise.**

| Brand | SNK* | Mean (std) |
|---|---|---|
| Young Dental (white cup) | | 83.3 (1.15) decibels |
| Young Dental (gray cup) | | 83.0 (1.41) decibels |
| Denticator | | 81.3 (4.44) decibels |
| Ash/Dentsply | | 78.5 (6.13) decibels |
| Brahler | | 77.4 (2.31) decibels |
| Teledyne Getz | • | 70.8 (2.65) decibels |

*Student-Newman-Keuls Multiple Comparison Test
One-way ANOVA, $p$=.0001

The disposable prophylaxis angles were evaluated for torque in two separate tests. The first torque test was performed to evaluate the amount of torque required just to turn the prophy cup that came attached to the disposable prophylaxis angle as received from the manufacturer. To perform the test, 10 samples of each brand of disposable prophylaxis angle were tested utilizing a Waters torque watch gauge (Wayland, MA). The second test for torque was performed to measure the amount of torque required to destroy the gear in the disposable prophylaxis angle. Again, 10 samples of each brand were tested with the Waters torque watch gauge and the amount of torque required to destroy the gear (reported in inch/ounces) was recorded.

## Results

For each of the variables tested (vibration, noise, heat rise, and torque) means, standard deviations, standard errors, and coefficients of variation were computed for each brand. One-way analysis of variance was performed for each variable to detect significant differences in the brand means, and the Student-Newman-Keuls Multiple Comparison Test[7] was performed to specifically determine which brands were different from each other.

The results of the test for vibration are reported in Table I. As can be seen, the Ash/Dentsply and Brahler disposable prophylaxis angles demonstrated statistically significantly greater vibration ($p$=.0024) than the Denticator, Teledyne Getz, or Young Dental Mfg. disposable prophylaxis angles.

The results of the test for noise are presented in Table II. The Teledyne Getz disposable prophylaxis angle was statistically significantly quieter ($p$=.0001) than any of the other brands.

The results of the test for heat rise are reported in Tables III and IV. Table III contains the results of the test for heat rise performed on the body of the disposable prophylaxis angles, and Table IV contains the results of the test for heat rise performed on the head of the disposable prophylaxis angles. As reported in Table III, the Ash/Dentsply disposable prophylaxis angles had a statistically significantly greater heat rise ($p$=.0001) in the body of the disposable angle from 68°F than did any of the other brands. The Ash/Dentsply disposable prophylaxis angle demonstrated a statistically significant (p=.0001) greater heat rise in the head of the angle than any of the other brands. It should be noted, however, that even with a mean heat rise of 20.2 degrees, the angle did not reach body temperature.

The disposable prophylaxis angles were tested for the amount of torque required to turn the prophy cup that was

**Table III**

**Comparison based on mean body temperature changes from 68°F.**

| Brand | SNK* | Body mean (std) |
|---|---|---|
| Ash/Dentsply | • | 17.00 (4.05)° |
| Denticator | | 9.50 (3.37)° |
| Young Dental (gray cup) | | 9.30 (2.58)° |
| Teledyne Getz | | 9.30 (3.23)° |
| Young Dental (white cup) | | 7.80 (1.98)° |
| Brahler | | 7.60 (2.91)° |

*Student-Newman-Keuls Multiple Comparison Test
One-way ANOVA, $p$=.0001

**Table IV**

**Comparison based on mean head temperature changes from 68°F.**

| Brand | SNK* | Head mean (std) |
|---|---|---|
| Ash/Dentsply | • | 20.80 (6.25)° |
| Teledyne Getz | | 10.80 (4.51)° |
| Denticator | | 10.60 (9.50)° |
| Young Dental (gray cup) | | 9.60 (2.59)° |
| Brahler | | 8.30 (2.98)° |
| Young Dental (white cup) | | 8.20 (2.69)° |

*Student-Newman-Keuls Multiple Comparison Test
One-way ANOVA, $p$=.0001

**Table V**

**Comparison based on torque required to destroy gear.**

| Brand | SNK* | Mean (std) |
|---|---|---|
| Brahler | • | 10.20 (1.76) inch/ounces |
| Young Dental (gray cup) | | 8.90 (1.12) inch/ounces |
| Ash/Dentsply | | 8.70 (0.71) inch/ounces |
| Teledyne Getz | | 8.50 (1.10) inch/ounces |
| Young Dental (white cup) | | 7.45 (1.72) inch/ounces |
| Denticator | • | 4.45 (0.43) inch/ounces |

*Student-Newman-Keuls Multiple Comparison Test
One-way ANOVA, $p$=.0001

provided on the angle as received from the manufacturer. The results of this test are not reported, as the torque required to turn each of the cups for each different brand was too slight to be measured, and was, therefore, not statistically significant. The results of the test performed to determine the amount of torque required to destroy the gear of the disposable prophylaxis angles is reported in Table V. The Brahler disposable prophylaxis angle required statistically significantly more torque ($p$=.0001) to destroy the gear than did any other brand, while the Denticator brand required statistically less torque ($p$=.0001) than did any of the other brands.

## Conclusions

Because the market for disposable dental products is expanding due to demand, it would behoove the consumer of these products to investigate the mechanical efficiency and efficacy of these products, such as the disposable prophylaxis angles, before making a product purchase. Disposable prophylaxis angles that will perform without mechanical interruption will certainly be less expensive and cause less frustration on the part of the oral healthcare provider. The results of this investigation reveal that of the brands tested, four have proven to be reliable when considering vibration, noise, heat rise, and torque: (in alphabetical order) Denticator, Teledyne Getz (Densco), and Young Dental Mfg. The Ash/Dentsply had significant heat rise in the head and body and also demonstrated significant vibration. The Brahler disposable prophylaxis angle also demonstrated significant vibration.

While this in vitro investigation has provided the oral healthcare provider with some information on which purchasing decisions can be made, it is even more important to have clinical information on which to make decisions regarding product selection. Currently, a clinical evaluation of these same brands of disposable prophylaxis angles is under way.

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