In Vitro Comparison of 360° Unirotational Disposable Prophylaxis Angles Versus 90° Reciprocating Disposable Prophylaxis Angles on Spatter During Rubber Cup Polishing

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IN VITRO COMPARISON OF 360° UNIROTATIONAL DISPOSABLE PROPHYLAXIS ANGLES VERSUS 90° RECIPROCATING DISPOSABLE PROPHYLAXIS ANGLES ON SPATTER DURING RUBBER CUP POLISHING

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ABSTRACT

IN *VITRO* COMPARISON OF 360° UNIROTATIONAL DISPOSABLE PROPHYLAXIS ANGLES VERSUS 90° RECIPROCATING DISPOSABLE PROPHYLAXIS ANGLES ON SPATTER DURING RUBBER CUP POLISHING

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The purpose of this in *vitro* study was to compare the traditional 360° unirotational disposable prophylaxis angle (DPA) to a 90° reciprocating DPA in terms of spatter production. The 2x3x3 factorial design involved: 2 types of DPAs x 3 types of prophylaxis pastes (fine, medium and coarse) x 3 dental handpiece revolutions per minute (rpm) settings (1500, 2000, and 3000). The eStylus™ operated the DPAs under controlled speeds. Using a mounted dental manikin, 90° reciprocating DPAs and 360° unirotational DPAs were evaluated for spatter production with the use of prophylaxis pastes of various grits in 270 laboratory trials. For each trial, a board measuring five by four feet was covered with graph paper. The graph paper apparatus was placed two inches below a dental manikin's chin. Facial aspects of mandibular teeth were polished from first molar to first molar. One drop of dyed saliva substitute was applied to each tooth. The rubber cup was filled with prophylaxis paste and each tooth was polished for three seconds. Spatter accumulation was measured by counting the number of dye droplets found on each of the squares on the graph paper. Fifteen trials for each independent variable interaction were conducted and means and standard deviations were computed. Data was analyzed using the three-way ANOVA at the .05 level of significance.

Results revealed a statistically significant difference between the amounts of spatter produced with a 90° reciprocating DPA verses traditional 360° unirotational DPA. The 90° reciprocating DPA produced significantly less spatter than the traditional 360° unirotational DPA. Results revealed no statistically significant difference in the spatter generated by fine, medium, or coarse grit prophylaxis pastes when using the 90° reciprocating DPA. However, results reveal that when using the 360° unirotational DPA, the type of prophylaxis paste was a significant factor in the amount of spatter production. The 360° unirotational DPA produced significantly more spatter with increasing rpm. Conversely, there was no difference in the amount of spatter produced by 1500, 2000, or 3000 rpm while using the 90° reciprocating DPA. In conclusion, the 360° unirotational DPA produces significantly more spatter than the 90° reciprocating DPA.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In the oral healthcare environment, clinicians and clients can be exposed to pathogenic agents including cytomegalovirus, hepatitis viruses, herpes simplex virus, mycobacterium tuberculosis, staphylococci, streptococci and a host of other microorganisms that infect the oral cavity and respiratory system. These infectious agents can be spread through direct contact with oral body fluids; contaminated instruments, environmental surfaces and equipment; contact of eye, nose and oral mucous membranes with contaminated airborne droplets (spatter); and inhalation of contaminated airborne droplets.

Until recently, to remove extrinsic tooth stains, dental professionals had one choice, a continuous 360° unirotational rubber cup prophylaxis angle attached to a slow-speed handpiece and used with fine, medium or coarse grit prophylaxis paste. Unfortunately, the design mechanism of this traditional rubber cup prophylaxis angle disburses infectious spatter from the oral cavity throughout the treatment area. Prophylaxis angles, because of the oral fluid and blood contaminated spatter they produce, have been an ongoing infection control concern for oral health professionals, the United States Occupational Safety and Health Administration and the Centers for Disease Control and Prevention (CDC, 2003). Researchers have documented that the 360° rotation combined with saliva, blood and prophylaxis paste causes infectious spatter to contaminate the air, people, and inanimate environmental surfaces in the treatment room, particularly the skin and clothes of the healthcare provider (Abel, Micik, Miller, & Ryge, 1971).

In 2002, a reengineered 90° reciprocating prophylaxis angle, the "TWIST™"* (formally called TWIST2IT) was marketed. In terms of prophylaxis angle design, it uses a unique 90° reciprocating mechanism that is reported to produce no spatter, compared to traditional 360° unirotational prophylaxis angles (Herekar & Lacefield, 2003). The 90° reciprocating prophylaxis angle differs from the 360° unirotational prophylaxis angle in engineered design (See Appendix A). The traditional angle spins 360° in one direction where as the 90° reciprocating angle rotates back and forth in a 90° arc. The purpose of this study was to compare the 360° unirotational prophylaxis angle to a new 90° reciprocating prophylaxis angle in terms of the amount of spatter produced during use (See Appendix B).

Statement of the Problem

The intent of this study was to determine which of the two major disposable prophylaxis angle designs on the market is most effective in minimizing spatter. The specific research problems addressed were to:

1. Compare the traditional 360° unirotational prophylaxis angle to a newly designed 90° reciprocating prophylaxis angle in terms of the amount of spatter produced during use.

2. Determine if the amount of spatter, regardless of prophylaxis angle selected, is affected by prophylaxis paste abrasivity used (fine, medium or coarse grit).

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*Twist™ is the trade name for a reciprocating prophylaxis angle. It will be referred to as a 90° reciprocating prophylaxis angle throughout the paper. In July 2007, the company was purchased by Crosstex® who now distributes this product.

3. Determine if the amount of spatter, regardless of prophylaxis angle used, is affected by dental handpiece rpm (1500, 2000 and 3000).

4. Determine if there is an interaction among the type of prophylaxis angle (90° reciprocating verses 360° continuous unirotational), abrasivity of the paste (fine, medium, coarse) and slow speed handpiece rpm used (1500, 2000 and 3000), in terms of spatter produced.

Significance of the Problem

Saliva and blood are potentially infectious biomaterials of concern in dental infection control protocols. Research on rubber cup prophylaxis angle design is significant because of the occupational risk of disease transmission encountered by oral healthcare professionals performing professional services which generate infectious spatter and contamination of the oral care environment. Dental prophylaxis angle use poses a risk of disease transmission via spatter generated when polishing restorations and removing extrinsic tooth stain. Specifically, rotary design rubber cup prophylaxis angle use has been shown to generate spatter within 10 inches of the operating field (Abel et al., 1971). If this newly designed disposable rubber cup prophylaxis angle (TWIST™) proves to reduce spatter under controlled conditions, then dental professionals will concurrently reduce disease transmission from spatter, and eliminate one link in the chain of infection during dental treatment.

The chain of infection includes an infectious agent (pathogenic microorganisms), a reservoir (mouth or saliva), a portal of exit (dental treatment procedures/ slow speed dental handpiece), a means of transmission (spatter), a portal of entry (eyes, mouth, nose, or break of the skin), and a host (susceptible people in the healthcare setting).

These six elements are required for infection to occur (Darby & Walsh, 2003).

According to Abel et al (1971), aerosols produced carry infectious agents that can enter the exposed mucous membranes of a person's eye, nose and or mouth allowing pathogenic microorganism's admittance to the body. Abel et al (1971) documented the potential of spatter contamination generated from dental instrumentation to dental clinicians with evidence of visible spatter observed and measured throughout the treatment room. Abel et al (1971) showed the 360° unirotational prophylaxis angle rotation combined with saliva, blood and prophylaxis paste causes infectious spatter to contaminate air, people and inanimate surfaces in the treatment room, including the skin and clothes of the provider. The CDC (2003) requires dental clinicians to minimize splashing, spraying and spattering during all procedures that may produce blood or infectious material by practicing universal standards to include the use of patient safety glasses, low and high speed evacuation, and materials and devices considered safe for use on patients. This study, therefore, supports this CDC requirement by comparing the spatter generated by two different prophylaxis angle designs to determine if the risk of contamination can be reduced.

Prophylaxis angles are used by dental hygienists in nonsurgical periodontal therapy, specifically the polishing phase of treatment to remove extrinsic stain from teeth. Polishing is desired by clients and may be a prime motivator for seeking care contributing to client satisfaction (Andrews, 2005). Until 2002, dental professionals had only one prophylaxis angle design to choose from, the air-powered slow-speed handpiece connected to an angle with a continuous 360° unirotational rubber cup. The operational mechanism of a 360° unirotational rubber cup prophylaxis angle propels infectious oral contamination in the treatment area (Abel et al, 1971); therefore, disposable prophylaxis angles remain an infection control issue in oral healthcare.

The potential for infectious contamination is increased throughout the treatment area when the prophylaxis angle with rubber cup and paste are activated and mixed with saliva and other infectious oral materials. Infectious diseases such as HIV, tuberculosis, and hepatitis have been transmitted to healthcare workers through spatter and aerosolization (Bentley, Burkhart, & Crawford, 1994). Oral healthcare professionals, concerned with the generation of spatter and aerosol production that occurs with prophylaxis angle use, are legally and ethically committed to prevent disease transmission with a variety of infection control strategies. Products, equipment or devices that can reduce this risk should be developed, evaluated, marketed and used to minimize or eliminate potential disease contamination during dental treatment.

Definition of terms

The following terms were defined as follows:

- Disposable Prophylaxis Angle (DPA) - a disposable rubber cup attached to an angle used in conjunction with a slow-speed dental handpiece and prophylaxis paste to remove extrinsic stain from teeth. This device is used once in the dental practice setting during a client encounter and then discarded. In this study, two types were compared as independent variables:

  A. Young Traditional 360° unirotational continuous direction design disposable prophylaxis angle (see Appendix B).

  B. TWIST™ new 90° reciprocating design prophylaxis angle (formally known as TWIST2IT) (see Appendix B).

- Spatter (also know as splatter)- droplets of saliva and blood larger than 50 microns generated from air-driven disposable prophylaxis angles during dental treatment and visible on safety glasses, clothing and other inanimate environmental surfaces in the dental treatment area. Visible dyed spatter droplets were counted on the graph paper following each trial.
- Prophylaxis paste- dense flavored paste containing varying sizes of grit particles of kaolinite, silicon dioxide, calcined magnesium silicate, diatomaceous silicon dioxide, pumice, sodium-potassium aluminum silicate, or zirconium silicate. This paste was used on the disposable rubber cup and angle to polish the teeth on the dental manikin apparatus. Three types of Nupro® Prophylaxis paste; fine, medium and coarse were used as independent variables in this study.
- Grit- rough various sized granules of an abrasive such as kaolinite, silicon dioxide, calcined magnesium silicate, diatomaceous silicon dioxide, pumice, sodium-potassium aluminum silicate, or zirconium silicate which is added to prophylaxis paste to aid in the removal of extrinsic stain.
- Extrinsic stain- removable tooth discolorations located on hard tooth structure, calculus, restorations, or prosthetic appliances. Stain should be removed to eliminate a nidus for bacterial plaque biofilm formation and for aesthetic reasons (Darby & Walsh, 2003).
- Revolutions per minute (rpm) - measure at which a slow-speed dental handpiece with a rubber cup prophylaxis angle attachment is operated in the oral cavity for extrinsic stain removal. The typical speeds used during the dental hygiene process of care range from 6,000 to 10,000 rpm (Wilkins, 2005), however, Christianson and Bangerter (1984) found that most dental hygienists use approximately 2700 rpm while polishing.

In the study, three levels of rpm were used as independent variables: 1500 rpm, 2000 rpm, and 3000 rpm.

Assumptions

For the purpose of this study, the following assumptions have been made:

1. The laboratory-based simulation provided a reasonably accurate model of what may occur in the clinical setting.
2. The 90° reciprocating prophylaxis angle is at least as effective in tooth stain removal as the leading brand of disposable prophylaxis angles.
3. The white graph paper set up around a dental manikin apparatus provided a realistic depiction of the spatter dispersion that can occur during the oral healthcare encounter.
4. The greater the speed of the slow-speed dental handpiece, the greater the spatter produced; therefore, 3 levels of rpm were used: 1500, 2000, and 3000 rpm.
5. The various levels of the independent variables in the study were representative of the range of variables used by dental hygienists during rubber cup polishing on clients.

Limitations

The following might have affected the internal and external validity of this study:

1. Use of low verses high-volume evacuation of the mouth during the extrinsic stain removal procedure affects the amount of spatter propelled into the environment (Bentley et al., 1994). Low and high speed evacuation was not necessary in the laboratory simulation, and therefore was not measured.
2. The laboratory setting did not include real-life influences such

as amount of saliva, presence of microorganisms, and variations in equipment and techniques used by different clinicians.

3. The amount and consistency of saliva present in a client's mouth could affect the amount and disbursement of spatter generated. A consistent amount of saliva substitute was applied in each trial. Saliva substitute is thicker in consistency compared to natural human saliva, therefore limiting the external validity of the outcomes.
4. Given the controlled laboratory environment of the study, research outcomes must be generalized prudently to the clinical setting.
5. The prophylaxis paste used was NUPRO®; therefore, other brands were not tested to determine their effect on amount of spatter production and the results cannot be generalized to any other brand of prophylaxis paste.

Hypotheses

The following hypotheses were tested at the .05 level:

1. There is no statistically significant difference between the amount of spatter produced with a 90° reciprocating prophylaxis angle verses the 360° unirotational prophylaxis angle, as measured by amount of spatter droplets counted on a graph paper apparatus.
2. There is no statistically significant difference with either the 360° unirotational prophylaxis angle or the 90° reciprocating prophylaxis angle when comparing amount of spatter generated by fine, medium, and coarse grit prophylaxis pastes, as measured by amount of spatter droplets counted on a graph

paper apparatus.

3. There is no statistically significant difference in the spatter generated by 1500 rpm, 2000 rpm, and 3000 rpm, when comparing the two different angles as measured by amount of spatter droplets counted on a graph paper apparatus.
4. There is no statistically significant interaction among type of prophylaxis angle (unirotational verses 90° reciprocating), prophylaxis paste abrasivity (fine, medium, coarse), and rpm at which the handpiece is operated (1500, 2000, or 3000 rpm), as measured by amount of spatter droplets counted on a graph paper apparatus when comparing the two different angles.

CHAPTER II

REVIEW OF THE LITERATURE

Dental prophylaxis angles, because of their tendency to generate contaminated spatter, pose a risk of disease transmission during their use in polishing restorations and extrinsic stain removal. The rotary design of the prophylaxis angle disperses spatter comprised of saliva, prophylaxis paste and blood throughout the treatment room including the people in the room (Herekar & Lacefield, 2003). Contaminated spatter and aerosol production has been studied in regards to high-speed dental handpiece and ultrasonic scaler use (Bentley, Burkhart & Crawford, 1994); however, few studies could be found on contamination potential from extrinsic stain removal with the disposable prophylaxis angle. Therefore, literature on spatter and aerosol contamination in dental practices and CDC dental infection control guidelines (2003) served as the theoretical foundation for this study.

Spatter and Aerosol Contamination in the Dental Practice Setting

The American Dental Association (ADA) is an organization that develops accreditation standards for the American Standards Institute (ANSI). ADA specifications have been approved by the ANSI and are therefore designated as ANSI/ADA specifications. ANSI/ADA specification 85- Part 1 covers disposable prophylaxis angles. The purpose of the standard is to provide general requirements to assure that the device design maintains safety and performance efficiency. Biocompatibility, attachments, packaging, labeling, instructions, housing, long gear mandrel, speed load, temperature, rise, vibration, and product testing are specified for disposable prophylaxis angles in the standard.

The United States Air Force Dental Investigation Service (DIS) conducted a product evaluation on the 90° reciprocating prophylaxis angle compared to the traditional 360° unirotational prophylaxis angle that included laboratory and clinical user testing (Belde, 2002). The laboratory evaluation was conducted according to ANSI/ADA Specification No. 85 Part 1- Disposable Prophylaxis Angles (ANSI/ADA, 2004). The study consisted of the evaluation of surface heat production on the tooth surface, heat production and the amount of spatter produced during operation, extrinsic stain removal effectiveness, size of the angle, and overall performance of the 90° reciprocating prophylaxis angle compared to the traditional 360° unirotational prophylaxis angle. Results of laboratory testing performed by Belde (2002) suggest that the TWIST™ meets the standard of the ANSI/ADA Specification 85- Part 1 and is safe and effective for use. In addition, the DIS compared cost and packaging of the 90° reciprocating and 360° unirotational prophylaxis angles. The cost of the two angles is relatively comparable ranging from 49-59 cents per angle. The author (Belde, 2002) found that packaging requirements were met for each angle, specifically: instructions for use, latex content and manufacturer batch and lot numbers.

In the clinical user phase Belde (2002) recruited five participants (two dentists and three dental hygienists) to use the 90° reciprocating and 360° unirotational prophylaxis angles and, complete a self-report questionnaire on their clinical use. All the participants reported considerably less spatter produced by the TWIST™ as compared with the unirotational model. Results revealed fair to good stain removal ability, less heat production, and greater ease of use. Although data were limited and the sample small, the researcher concluded that the 90° reciprocating prophylaxis angle produced less spatter than the traditional prophylaxis angle.

Bentley, Burkhart, and Crawford (1994) evaluated spatter, aerosol distribution, and contamination from high-speed instrumentation both in a laboratory and clinic during dental treatment. Dental procedures were preformed in a laboratory on manikins, with dye representing the spatter and aerosol production; white filter paper disks were used to detect the amount of contamination. The same dental procedures were then replicated on human subjects. Contaminated spatter was collected on blood agar plates located throughout the room. The plates were incubated for 48 hours at 37° Celsius and the bacterial colony forming units were counted and analyzed.

Laboratory results revealed that spatter from the dental procedures was disbursed upward in vertical, expanding, funnel shaped, circular patterns on the clinician's face, arms and chest. Strikingly noticeable was the amount of fluorescent dye around the clinician's mask even though a face shield was worn. In the clinical setting, the amount of spatter and aerosol contamination disbursed during an actual procedure on human subjects varied depending on the area of the mouth undergoing treatment and the dental procedure used. The researchers found that although dental clinicians wear protective barriers, they are still exposed to infectious spatter and aerosols during many dental procedures as evidenced by visible spatter on protective wear. The researchers concluded that spatter and aerosol production during dental treatment remains a health hazard to dental clinicians particularly when high-speed dental equipment is used. Outcomes from the clinical portion of the study were influenced by high volume suction used during the restorative procedures and low-volume suction used during ultrasonic scaling to remove excess saliva present in the client's mouth, as well as the varying amount of plaque (currently referred to as dental plaque biofilm, [Gurenlian, 2007]) in each of the subject's mouths.

Abel, Micik, Miller, and Ryge (1971) evaluated the distribution and bacterial content of spatter caused by dental treatment procedures in a controlled operatory. The apparatus used in this study was constructed of five wooden battens three feet above the floor with suction cups spaced at one foot intervals from the patient's mouth to the end of the room. The battens were mounted allowing them to rotate 360° on their long axes. Petri dishes filled with heart infusion agar were attached to the suction cups on the battens (see Figure 1). This feature allowed the Petri dishes to be covered and uncovered automatically without risk of contamination by persons attempting this action.

Figure 1. Wooden batten apparatus used to detect and measure spatter (Abel, et al, 1971)

Effects of client behaviors (normal breathing, speaking, yelling, sneezing, coughing, hissing, toothbrushing, and gargling), and the effects of dental procedures (tooth preparation with a high-speed handpiece; prophylaxis with a rubber cup, slow speed handpiece and pumice; restoration polishing with a bristle disk; 3-way air-water syringe tip, air and water use; and the use of an ultrasonic scaler) on spatter and aerosol production were evaluated in 30 second intervals. Spatter was measured in inches ranging from 6-48 inches from the client's mouth. Extrinsic stain removal with a rubber cup yielded moderate bacterial concentration as evidenced by a bacterial count between 1,000 and 10,000 cfu/ft^2 and measured within 10 inches of the operating field as evidenced by distance from patient to agar plates. Researchers concluded that dental professionals and patients are exposed to significant amounts of infectious agents and materials during dental treatment. Reduction in spatter or spatter prevention by altering procedures (using high-volume suction, preprocedural mouthrinses or toothbrushing) and taking precautionary measures to prevent contamination with proper personal protection barriers (masks, eye glasses and face shields, proper equipment, and careful technique) is recommended.

Many viral agents that can be found in saliva include but are not limited to herpes simplex virus (HSV), Epstein-Barr virus, and cytomegalovirus. Blood can contain hepatitis viruses and respiratory aerosols can contain *Mycobacterium tuberculosis.* Many dental procedures cause spatter and aerosol production that contribute to the transmission of these diseases in the care setting. A study evaluating chemical inactivation of viral agents in handpiece spatter by Ceisel, Osetek, Turner, and Spear (1995) demonstrated the hazards of dispersion of infectious agents during dental handpiece use. Ethanol and sodium hypochlorite (NaOCL) disinfectants were added to the dental unit water lines for the experiments conducted by Cesial et al because they are capable of inactivating broad spectrum microbial agents; for the control, a dental unit with sterile water was used. Vero cells (African green monkey kidney cells obtained from the American Type Culture Collection) were used in this study as they lyse in the presence of the Herpes virus thus making the colonies easy to count after staining. Viral plaque assays were preformed on the Vero cells; they were incubated and stained for colony growth and visibility. During experiment one, the Vero cells were exposed for one hour to the HSV-1 virus, and then exposed to the ethanol or NaOCl for one hour. Experiment two tested the HSV-1 virus sensitivity to direct contact with the disinfectants for various times periods.

For the dispersion and collection of HSV in spatter, a box was designed with a Plexiglas cover. Inside the box, one wooden post was placed in the center with three other posts forming an arc 20 centimeters from the center and 10 centimeters from each other. A dappen dish filled with the HSV-1 virus was placed on the center post and each of the remaining posts held a Petri dish of Vero cells in 1 ml of phosphate-buffered saline. A Midwest® high-speed handpiece and contra-angle was used with a carbide bur, and attached to a portable dental unit with either sterile water or chemical disinfecting agents in the water bottle. The handpiece was run for 30 seconds over the dappen dish and Petri dishes for spatter collection and then incubated (no direct contact was made with the virus). The HSV-1 was detected throughout the spatter droplets despite having no direct contact with the virus. Results suggest that NaOCl is capable of inactivating lipid coated viruses in dental handpiece spatter; however, further studies are required to determine the safety and efficiency of these and additional disinfectants.

CDC Guidelines for Prevention of Disease Transmission

The CDC promulgates infection control recommendations for dental settings by guiding dental professionals on how to control infectious disease exposure during dental treatment. Dental treatment, whether invasive or non-invasive, can expose patients and dental professionals to pathogenic microorganisms transmitted in dental settings through contact with blood, saliva, and other infectious materials such as contaminated instruments, equipment, or environmental surfaces.

Standard precautions (formerly known as universal precautions) require healthcare workers to treat all patients as infectious. These standard precautions are the protocol to protect patients and healthcare workers from transmission of infectious diseases. In addition to the use of personal protective equipment such as gloves, safety glasses and masks, practitioners must create and maintain safe and effective equipment to decrease or eliminate exposure to potentially infectious materials.

This review of the literature establishes a common ground regarding spatter production generated with disposable prophylaxis angles and thus a risk of disease transmission as a result of extrinsic stain removal procedures. Although standard precautions have been adopted to protect patients and dental professionals via the wearing of personal protective equipment to decrease the risk for disease transmission; these precautions do not eliminate the risk of disease transmission from the source of spatter generation. In addition, products, equipment or devices that can reduce this risk further should be developed and evaluated to minimize or eliminate potential disease contamination during dental treatment procedures.

CHAPTER III

METHODS AND MATERIALS

Sample Selection and Description

Using a dental manikin with mounted dentition and simulated soft tissue in 270 laboratory trials, 90° reciprocating disposable prophylaxis angles and 360° unirotational disposable prophylaxis angles were evaluated for spatter production when used with prophylaxis pastes of various grits on the facial surfaces of select mandibular teeth in the dental manikin's mouth. Each prophylaxis angle was tested 135 times each at three different set rpm (1500, 2000, 3000 rpm) using three different levels of prophylaxis paste grits (fine, medium, coarse). For each trial, two sheets of white graph paper measuring 54 x 64 inches were attached to a ¼ inch foam board used to collect spatter disbursed during the dental prophylaxis procedure trials. The foam board measuring four feet in length and five feet wide was placed two inches below the chin of the dental manikin. Biotene® saliva substitute drops were used to simulate natural saliva. Disclosing solution was added to the saliva substitute to easily visualize the spatter droplets. For each trial, one drop of saliva substitute was placed on the facial surface of each tooth from first molar to first molar on the mandibular arch and the prophylaxis angle was used on each tooth for three seconds. Following each trial, the dental manikin apparatus was thoroughly cleaned and dried and a new prophylaxis angle and unit of prophylaxis paste was used. Spatter generation was measured by counting the number of dye droplets found in each of the squares on the graph paper.

Research Design

Using a 2x3x3 factorial design, two different disposable prophylaxis angles were examined. This design allowed the researchers to examine the main effects of each of the three independent variables (type of prophylaxis angle, level of abrasive, and rpm); the researchers then examined the double interaction effects of angle x abrasive, angle x rpm, and abrasive x rpm (see Table 1). Finally, the researchers examined the triple interaction effects of all variables across all 18 cells.

Table 1. 2x3x3 Factorial Research Design

90° Reciprocating Prophylaxis Angle				360° Unirotational Prophylaxis Angle			
	1500rpm	2000rpm	3000rpm		1500rpm	2000rpm	3000rpm
Fine	15	15	15	Fine	15	15	15
Medium	15	15	15	Medium	15	15	15
Coarse	15	15	15	Coarse	15	15	15

The eStylus™, manufactured by Dentsply, was used to operate the prophylaxis angles and slow-speed handpiece with constant revolutions per minute. Independent variables in the design paradigm involved: 2 types of angles x 3 levels of prophylaxis paste (fine, medium and coarse grit) x 3 different rpm (1500, 2000, and 3000) for powering the rubber cup prophylaxis angles. The dependent variable, spatter, was measured by counting the dyed spatter droplets that accumulated on the white graph paper apparatus positioned around the dental manikin. Spatter was measured 15 times with each prophylaxis angle using each of the three rpm and three levels of prophylaxis paste grits; therefore, 15 trials x 2 prophylaxis angles x 3 speeds x 3 prophylaxis paste grits resulted in 270 trials.

Using a mounted dental manikin with simulated soft tissue, the 90° reciprocating prophylaxis angles and the traditional 360° unirotational prophylaxis angles were used with a mixture of saliva substitute tinted with disclosing solution and prophylaxis paste of various grits in selected areas of the mouth. Biotene® saliva substitute drops were used to simulate the role of saliva in rubber cup polishing procedures and the disclosing solution made the spatter visible (see Figure 2). This design controlled for the effects of each of the three independent variables (prophylaxis angle, level of prophylaxis paste, and rpm). Manufacturer recommended action and 3000 maximum rpm as described in Appendix B, were used to provide results that can be related to actual clinical application and increase the external validity of the study.

Figure 2. Biotene® saliva substitute drops

Procedures, Materials, Data Collection Instrument(s)

Prior to the actual study, a pilot study was conducted to establish intrarater reliability. During the pilot study, white graph paper sheets measuring 54 x 64 inches were exposed to the spatter produced during the prophylaxis procedure during two separate laboratory trials. The first trial tested the 90° reciprocating angle with fine grit prophylaxis paste and during the second trial tested the 360° unirotational prophylaxis angle with fine grit prophylaxis paste. The facial aspects of the mandibular teeth were polished from first molar to first molar. One drop of dyed saliva substitute was applied to each tooth, preparing three teeth at a time. The rubber cup was filled with prophylaxis paste of various grit levels and each tooth was polished for three seconds. Prophylaxis paste was reapplied to the rubber cup after polishing every third tooth. The dye droplets (spatter) on the graph paper were counted for each trial and recounted by the same dental hygienist examiner to determine a consistent number of spatter droplets for each count. Pilot test results revealed no significant difference between the first or second count, hence establishing the intrarater reliability of the dental hygienist examiner taking the counts.

In a dental treatment area at the Dental Hygiene Research Center at Old Dominion University, a dental manikin with 32 synthetic teeth and simulated soft tissue was mounted on a dental chair in the reclined position. The eStylus™ which provided controlled rpm settings (1500, 2000, and 3000 rpm) was used to power the slow-speed handpiece and prophylaxis angles in the ranges used by most dental hygienists (Christensen & Bangerter, 1984). The eStylus™ includes a wireless detachable control display unit that can customize speed settings from 1500 rpm to 40,000 rpm (see Figure 3) with a foot pedal and a digital screen for easy viewing of the rpm setting.

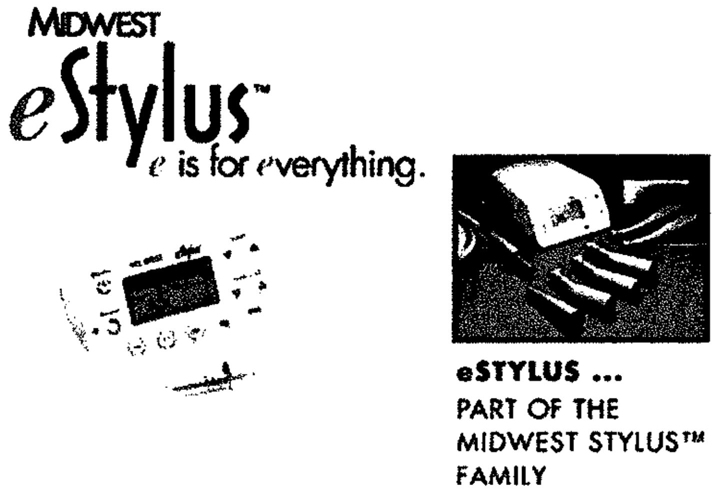

Figure 3. Midwest eStylus™ Handpiece system by Dentsply Professional
From: Dentsply Professional Product Information. (n.d.) Retrieved July 23, 2007, from http://prevent.dentsply.com/catalog/estylus/home.cfm

For each trial, a ¼ inch foam board measuring five feet wide and four feet in length was covered with two sheets of white graph paper measuring 54 x 64 inches. The graph paper apparatus was placed two inches below the chin of the dental manikin (see Figure 4). The facial aspects of the selected mandibular teeth were polished from first molar to first molar. These teeth were chosen because the simulated soft tissue allowed for easy access to these areas as opposed to the maxillary teeth where the soft tissue covered most of the teeth. One drop of dyed saliva substitute was applied to each tooth, preparing three teeth at a time. The rubber cup was filled with prophylaxis paste of one grit level and each tooth was polished for three seconds. Prophylaxis paste was reapplied to the rubber cup after polishing every third tooth. For each trial, a new disposable prophylaxis angle, a new unit of (fine, medium or coarse) prophylaxis paste, setting of (1500, 2000 or 3000) rpm, and new sheets of graph paper were used. The dental manikin was thoroughly washed and dried between trials. Graph paper sheets were labeled to identify trial and variables tested. Spatter accumulation was measured by counting the number of dye droplets found on each of the squares on the graph paper. Due to the smearing of the spatter droplets that occurred during the pilot testing, the counts were preformed immediately after each trial.

Figure 4. Mounted dental manikin apparatus over graph paper apparatus.

Statistical Treatment

To analyze the spatter generated by the 90° reciprocating prophylaxis angle and the 360° unirotational prophylaxis angle with three different prophylaxis paste grits and three different rpm settings of the handpiece, the mean, standard deviation and three-way analysis of variance were used. These statistical treatments were appropriate for analyzing ratio-scaled data from factorial designs when a large number of trials and samples are used. All hypotheses were tested at the .05 level. A statistician was consulted to validate statistical analysis and interpretation.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of the research was to compare the traditional 360° unirotational prophylaxis angle to a new 90° reciprocating prophylaxis angle in terms of the amount of spatter produced during use. A total of 270 trials were conducted in a laboratory setting at the Dental Hygiene Research Center at Old Dominion University. Each prophylaxis angle was tested 135 times at three different set rpm (1500, 2000, 3000 rpm) using three different levels of prophylaxis paste grits (fine, medium, coarse). Each trial consisted of polishing the facial surfaces of the mandibular teeth from first molar to first molar, with one drop of saliva substitute dyed with disclosing solution and applied to every third tooth. The rubber cup of the prophylaxis angle was filled with prophylaxis paste of various grit levels. Prophylaxis paste was reapplied to the rubber cup after polishing every third tooth, and each tooth was polished for three seconds. Following each trial, the graph paper was analyzed and the spatter droplets were counted by the same research assistant. The dental manikin apparatus was washed and dried thoroughly after each trial. Results were analyzed by a statistician using the mean, standard deviation, and three-way analysis of variance (ANOVA) tests.

Results

Hypothesis One. The first hypothesis predicted no statistically significant difference between the amounts of spatter produced with a 90° reciprocating prophylaxis angle verses traditional 360° unirotational prophylaxis angle, as measured by the amount of spatter droplets counted on a graph paper apparatus. The resulting means from each group of observations (N=15) were compared for both angles (N=270). Statistical analysis revealed a significant difference between the amount of spatter produced with the traditional 360° unirotational prophylaxis angle compared to the 90° reciprocating prophylaxis angle; therefore the null hypothesis was rejected (See Table 2).

Table 2. Mean and Standard Deviations of the 90° Reciprocating Prophylaxis Angle and the 360° Unirotational Prophylaxis Angle

Mean and Standard Deviations of the 90° Reciprocating Prophylaxis Angle and the 360° Unirotational Prophylaxis Angle

Analysis Variable: Spatter					
Angle	Paste	Speed	N Observations	Mean	SD
90° Reciprocating	Fine	1500	15	0.40	0.83
		2000	15	0.33	0.62
		3000	15	0.40	0.91
	Medium	1500	15	0.07	0.26
		2000	15	0.40	0.83
		3000	15	0.33	0.62
	Coarse	1500	15	0.47	0.74
		2000	15	0.53	0.74
		3000	15	0.33	0.82
360° Unirotational	Fine	1500	15	25.00	15.47
		2000	15	58.87	23.34
		3000	15	50.27	21.50
	Medium	1500	15	19.80	9.20
		2000	15	53.60	23.01
		3000	15	86.67	30.61
	Coarse	1500	15	19.67	7.72
		2000	15	24.13	10.11
		3000	15	64.33	32.80

A three-way ANOVA model was computed with angles (90° reciprocating and 360° unirotational), as one of the three independent variables and spatter as the dependent variable with a P-value set at $\leq .05$. Results revealed that the traditional 360° unirotational prophylaxis angle produced more spatter than the 90° reciprocating prophylaxis angle regardless of the effects of speed or grit abrasivity (See Table 3).

Table 3. Comparison of the Amount of Spatter Produced by the 90° Reciprocating Prophylaxis Angle Compared to the 360° Unirotational Prophylaxis Angle.

	F	df	P Value
Prophylaxis Angles	591.27	(1, 252)	<.0001

Hypothesis two. The second hypothesis predicted no statistically significant difference when comparing the 90° reciprocating prophylaxis angle with the 360° unirotational prophylaxis angle as measured by the amount of spatter droplets when using fine, medium and coarse grit prophylaxis pastes. Means and standard deviations were computed for each of the two angles when used with fine, medium and coarse grit prophylaxis pastes at various speeds (see Table 2). The three-way ANOVA was computed with a P-value set at the .05 level. Results revealed a statistically significant difference in the spatter generated by fine, medium, or coarse grit prophylaxis pastes as measured by the number of spatter droplets counted on the graph paper apparatus when comparing the 90° reciprocating prophylaxis angle with the 360° unirotational prophylaxis angle; therefore, the null hypothesis was rejected (See Figures 5, 6, and 7).

Table 4. 360° Unirotational Prophylaxis Angle ANOVA

	F	df	P Value
Prophylaxis Paste	7.52	(2, 126)	<.0008
rpm	52.22	(2, 126)	<.0001
Prophylaxis Paste/rpm	7.89	(4, 126)	<.0001

Table 5. 90° Reciprocating Prophylaxis Angle ANOVA

	F	df	P Value
Prophylaxis Paste	0.68	(2, 126)	0.5082
rpm	0.26	(2, 126)	0.7685
Prophylaxis Paste/rpm	0.47	(4, 126)	0.7560

Table 6. Comparison of Angle Design for Fine Prophylaxis Paste ANOVA

	F	df	P Value
Angle	212.59	(1, 84)	<.0001
rpm	11.14	(2, 84)	<.0001
Angle/rpm	11.21	(2, 84)	<.0001

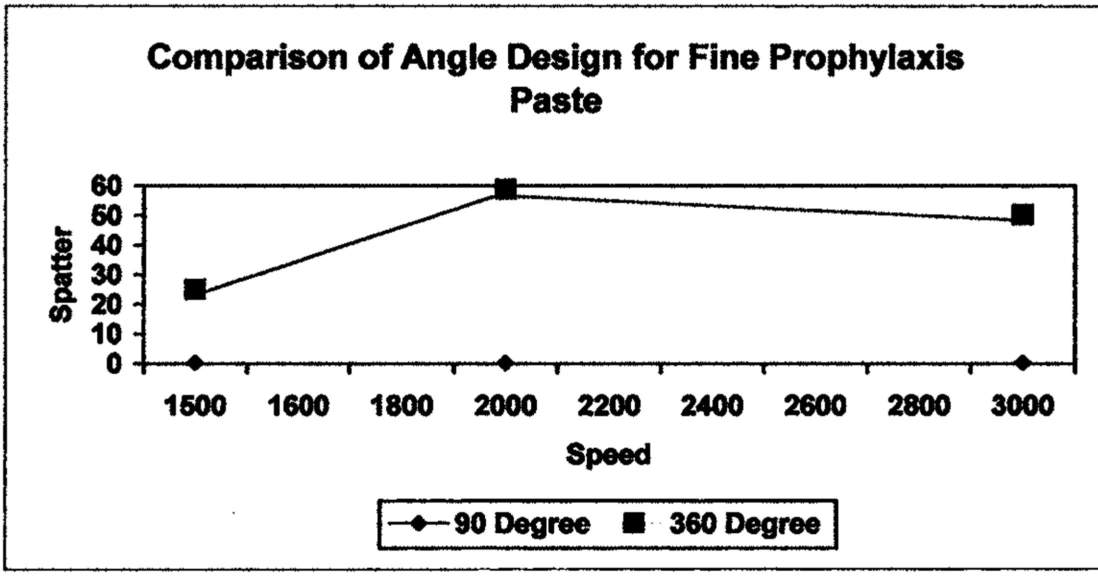

Figure 5. Comparison of angle design for fine grit prophylaxis paste.

Table 7. Comparison of Angle Design for Medium Prophylaxis Paste ANOVA

	F	Df	P Value
Angle	245.10	(1, 84)	<.0001
rpm	32.66	(2, 84)	<.0001
Angle/rpm	32.14	(2, 84)	<.0001

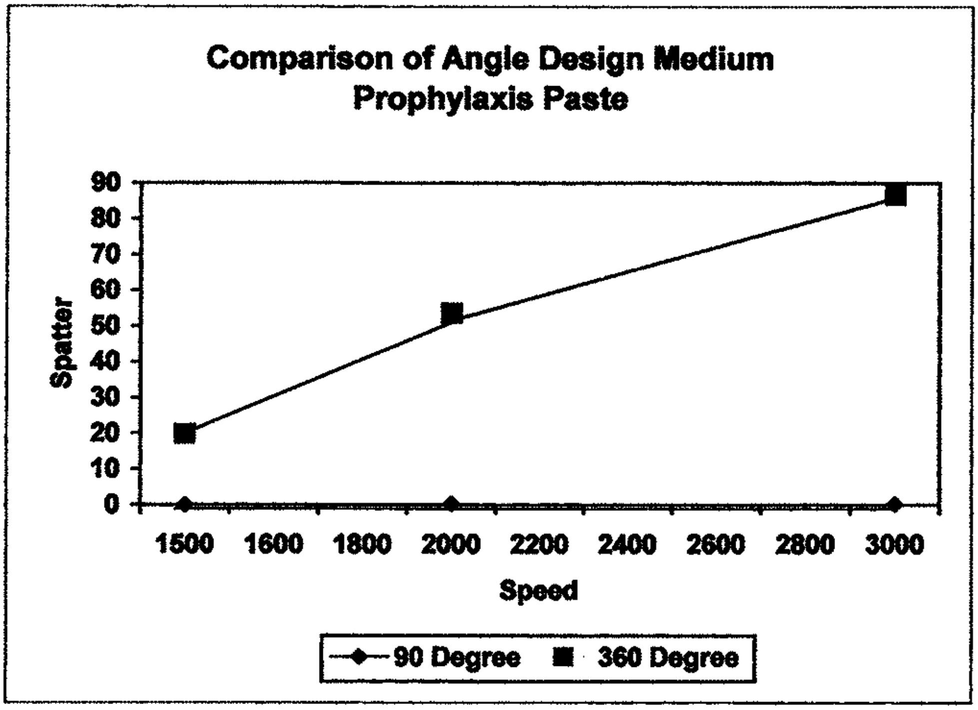

Figure 6. Comparison of angle design for medium grit prophylaxis paste.

Table 8. Comparison of Angle Design for Coarse Prophylaxis Paste ANOVA

	F	df	P Value
Angle	138.02	(1, 84)	<.0001
rpm	21.80	(2, 84)	<.0001
Angle/rpm	22.13	(2, 84)	<.0001

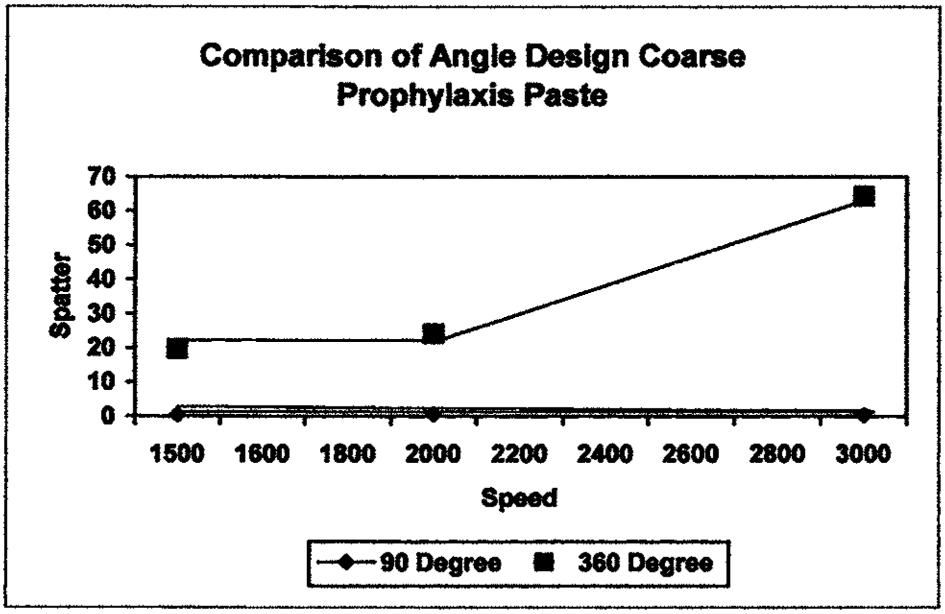

Figure 7. Comparison of angle design for coarse grit prophylaxis paste.

Hypothesis three. The third hypothesis predicted no statistically significant difference in the spatter generated by 1500 rpm, 2000 rpm, and 3000 rpm when comparing the 90° reciprocating prophylaxis angle with the 360° unirotational prophylaxis angle as measured by the number of spatter droplets counted on the graph paper apparatus. Means, standard deviations and ANOVA were computed for each of the two angles when operated at 1500, 2000, and 3000 rpm with various grits prophylaxis pastes. Results revealed a significant difference between the amount of spatter produced by 2000, and 3000 rpm when comparing the traditional 360° unirotational prophylaxis angle with the 90° reciprocating prophylaxis angle. When comparing the two angles at 1500 rpm, there was no significant difference in the amount of spatter produced. (See Table 2 and Tables 9-11).

Results demonstrate that the differences between the amounts of spatter generated were due to the angle design of the 360° unirotational prophylaxis angle, which produced significantly more spatter with increasing rpm, therefore; the null hypothesis is rejected. (See Tables 4 and 5) (See Figures 8, 9, 10).

Table 9. Comparison of Prophylaxis Angle Design for 1500 rpm ANOVA

	F	df	P Value
Prophylaxis Angle	157.32	(1, 84)	<.0001
Prophylaxis Paste	1.14	(2, 84)	0.3252
Angle/Paste	1.04	(2, 84)	0.3596

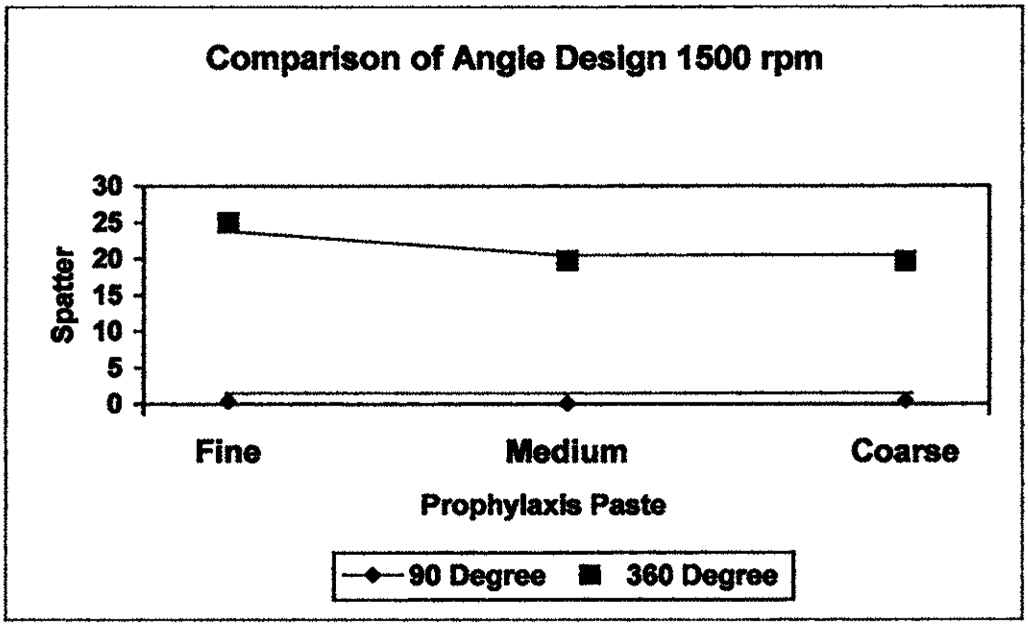

Figure 8. Comparison of angle design for 1500 rpm.

Table 10. Comparison of Prophylaxis Angle Design for 2000 rpm ANOVA

	F	df	P Value
Prophylaxis Angle	233.19	(1, 84)	<.0001
Prophylaxis Paste	13.24	(2, 84)	<.0001
Angle/Paste	13.53	(2, 84)	<.0001

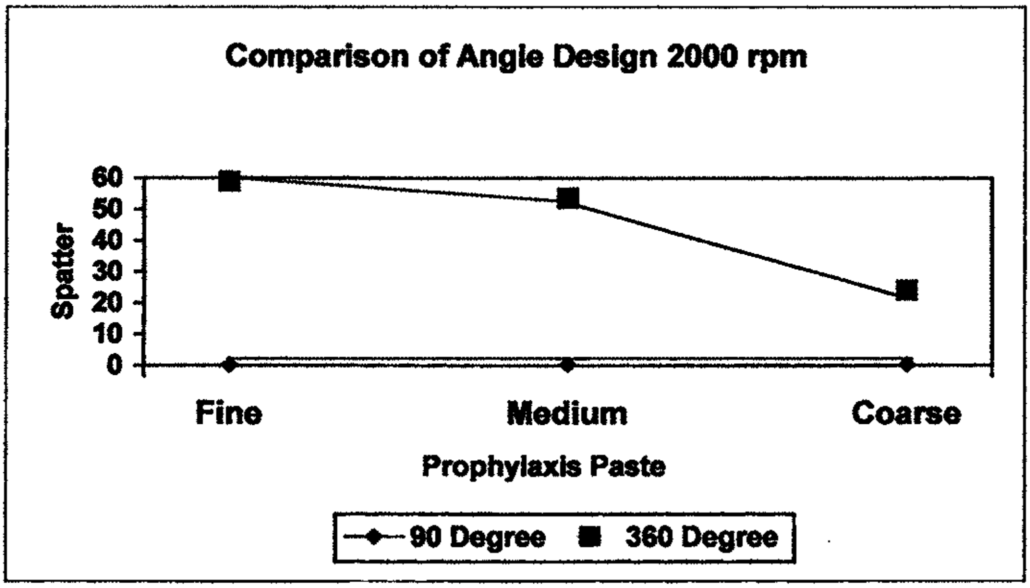

Figure 9. Comparison of angle design for 2000 rpm

Table 11. Comparison of Prophylaxis Angle Design for 3000 rpm ANOVA

	F	df	P Value
Prophylaxis Angle	242.70	(1, 84)	<.0001
Prophylaxis Paste	6.10	(2, 84)	0.0034
Angle/Paste	6.14	(2, 84)	0.0032

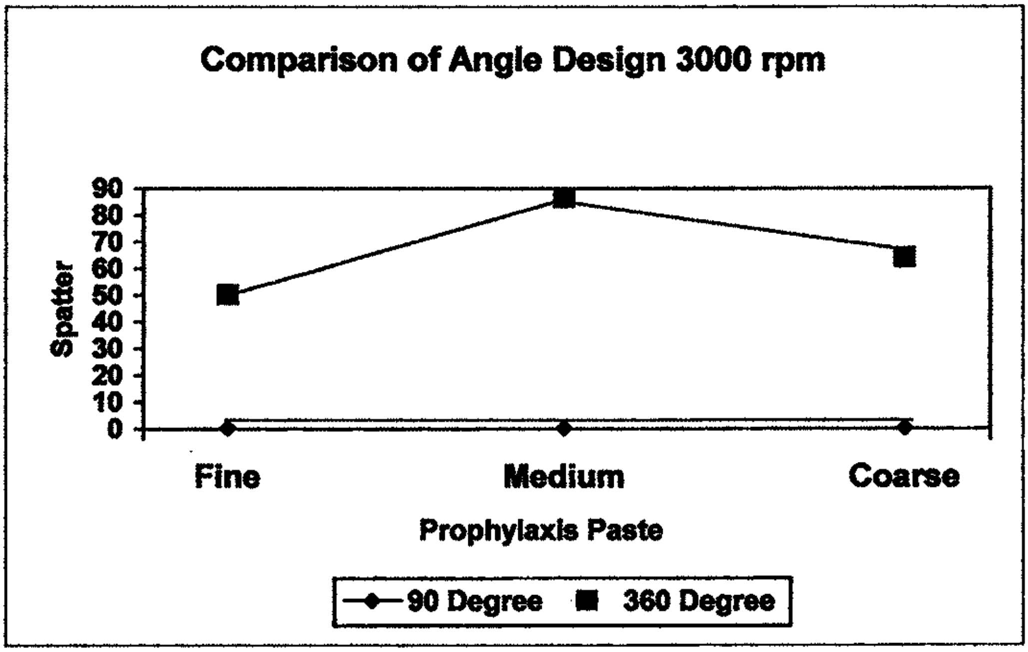

Figure 10. Comparison of angle design for 3000 rpm

Hypothesis four. The fourth hypothesis predicted no statistically significant interaction among type of prophylaxis angle, prophylaxis paste abrasivity and rpm as measured by amount of spatter droplets counted on the graph paper apparatus when comparing the two angles. Results revealed a statistically significant interaction among type of prophylaxis angle (360° unirotational verses 90° reciprocating), prophylaxis paste abrasivity (fine, medium, coarse), and rpm at which the handpiece is operated (1500, 2000, or 3000 rpm), as measured by amount of spatter droplets counted on the graph paper apparatus. No significant interaction was detected for 90° reciprocating prophylaxis angle, but all the effects were significant for the traditional 360° unirotational prophylaxis angle (see Tables 4, 5 and 12).

Table 12. Prophylaxis Angle, Prophylaxis Paste and rpm Interaction ANOVA

	F	df	P Value
Angle	591.27	(1, 252)	<.0001
Paste	7.36	(2, 252)	0.0008
Angle/Paste	7.67	(2, 252)	0.0006
rpm	52.27	(2, 252)	<.0001
Angle/rpm	52.05	(2, 252)	<.0001
Paste/rpm	7.89	(4, 252)	<.0001
Angle/Paste/rpm	7.88	(4, 252)	<.0001

Discussion

Since the 90° reciprocating prophylaxis angle is a relatively new product, only one published study could be found testing the effects if its design on the amount of spatter produced during regular prophylaxis use. Previous studies conducted on traditional prophylaxis angles focused mainly on heat generation and spatter production during use. The manufacturer of the 90° reciprocating angle has assertively marketed the angle's elimination of spatter during regular prophylaxis use (TWIST™ Brochure, 2007). Given that research on rubber cup prophylaxis angle design is significant because of the occupational risk of disease transmission by oral healthcare professionals performing services which generate infectious spatter contamination, this comparative study of the two prophylaxis angle designs was imperative.

Hypothesis One. Statistical analysis revealed that the traditional 360° unirotational prophylaxis angle produced a significantly greater amount of spatter during regular prophylaxis use. This finding suggests that use of the 360° unirotational prophylaxis angle has the potential to contaminate dental treatment areas with infectious oral materials during regular use. The 90° reciprocating prophylaxis angle produced little to no spatter during the in *vitro* trials. If spatter production results are similar in further in *vivo* tests, the 90° reciprocating angle maybe an ideal choice for dental personnel who are interested in breaking the chain of infection in the dental treatment area and reducing risk of contamination. Belde (2002) reported good stain removal results, less heat production and greater ease of use with the 90° reciprocating prophylaxis angle. In addition to less spatter production, the 90° reciprocating angle is equally effective in stain removal capability as reported by Lacross (2006). The cost of the 90° reciprocating prophylaxis angle is comparable to traditional 360° unirotational prophylaxis angles which retails for .49 to .59 cents per angle depending on product distributor. Findings support the use of the 90° reciprocating prophylaxis angle design.

Hypothesis two. The second hypothesis predicted no statistically significant difference with either the 90° reciprocating prophylaxis angle or the 360° unirotational prophylaxis angle when comparing the two different angles using fine, medium, and coarse grit prophylaxis pastes, as measured by amount of spatter droplets counted on a graph paper apparatus. Means and standard deviations were computed for each of the two angles when used with fine, medium and coarse grit prophylaxis pastes at various speeds (see Table 3). The three-way ANOVA was computed with a P-value set at the .05 level. Results revealed a statistically significant difference in the spatter generated by fine, medium, or coarse grit prophylaxis pastes when comparing the 90° reciprocating prophylaxis angle with the 360° unirotational prophylaxis angle as measured by the number of spatter droplets counted on the graph paper apparatus, therefore the null hypothesis was rejected (See Figures 5, 6, and 7).

Therefore the type of the grit particles in the prophylaxis paste used did affect the amount of spatter generated during the laboratory trials when comparing the 360° unirotational prophylaxis angle to the 90° unirotational angle. These findings are valuable for the practicing dental hygienist who uses various grits of prophylaxis paste as determined by degree of patient extrinsic stain accumulation. Regardless of the dental hygienist's selection of prophylaxis paste grit, he/she can be assured that low spatter production with the 90° reciprocating prophylaxis angle will be consistent. Consistently low spatter production translates into time savings for the dental hygienist in the infection control procedures between patients. No studies were found examining the spatter production from prophylaxis paste grits. These findings are limited to the use of NUPRO® brand prophylaxis polishing pastes; results may differ if the study is replicated using another brand of prophylaxis paste. These results are limited to a laboratory setting in the absence of natural saliva and without the use of low-speed evacuation; differences in saliva amounts and consistencies may influence spatter production. Given these results, dental professionals must consider the prophylaxis angle design to help eliminate spatter during regular prophylaxis procedures.

Hypothesis three. Statistical analysis revealed a significant difference between the amount of spatter produced by 2000, and 3000 rpm when comparing the traditional 360° unirotational prophylaxis angle to the 90° reciprocating angle. When comparing the two angles at 1500 rpm, there was no significant difference in the amount of spatter produced. The differences in the data are most likely due to the angle design of the 360° unirotational prophylaxis angle, which produced comparatively large quantities of spatter during each trial. Generally, as rpm increased, the amount of spatter droplets increased for all paste grits with the exception of the fine grit paste when operating the 360° unirotational prophylaxis angle. Further studies are needed to examine this finding. The 90° reciprocating prophylaxis angle generated no increase in spatter regardless of rpm. Further studies are indicated to determine whether the handpiece speed used by a dental hygienist during clinical extrinsic stain removal will produce similar results when using the 90° reciprocating prophylaxis angle and low speed evacuation. Typical speeds used during the dental hygiene process of care range from 6,000 to 10,000 rpm (Wilkins, 2005). Yet Christianson and Bangerter (1984) found that most dental hygienists use approximately 2700 rpm while polishing. Crosstex® recommends using 4000 rpm for optimum results when using the 90° reciprocating prophylaxis angle. Clinical studies are needed to determine the ideal rpm range during tooth polishing for effective stain removal and tooth safety. Findings are limited to a laboratory setting without human saliva.

Hypothesis Four. Results suggested a statistically significant interaction among type of prophylaxis angle (unirotational verses 90° reciprocating) prophylaxis paste abrasivity (fine, medium or coarse), and rpm at which the handpiece is operated (1500, 2000 or 3000 rpm), as measured by amount of spatter droplets counted on graph paper apparatus when comparing the two different angles. For the fourth hypothesis, results revealed no significant interaction effects detected for the 90° reciprocating prophylaxis angle, but all effects were significant for the traditional 360° unirotational prophylaxis angle. The 360° unirotational design of the traditional prophylaxis angle increases the amount of spatter generated. A limitation to this finding was the lack of patient saliva and the absence of low speed evacuation during each laboratory trial. The consistency of the saliva substitute used in this study did not replicate the consistency of human saliva, nor the fluctuating amounts of saliva in the oral cavity that vary from person to person. Further study is indicated under various clinical conditions to increase the external validity of this finding.

CHAPTER V

SUMMARY AND CONCLUSIONS

Via the oral healthcare environment, clinicians and clients can be exposed to pathogenic agents including cytomegalovirus, hepatitis viruses, herpes simplex virus, mycobacterium tuberculosis, staphylococci, streptococci and a host of other microorganisms that infect the oral cavity and respiratory system. These infectious agents can be spread through direct contact with oral body fluids; contaminated instruments, environmental surfaces and equipment; contact of eye, nose and oral mucous membranes with contaminated airborne droplets (spatter); and inhalation of contaminated airborne droplets. The design mechanism of a traditional rubber cup prophylaxis angle used to remove extrinsic stains from teeth disburses airborne infectious spatter throughout the treatment area. Prophylaxis angles, because of the oral fluid and blood contaminated spatter they produce, have been an ongoing infection control concern to oral health professionals, the United States Occupational Safety and Health Administration (2001) and the Centers for Disease Control and Prevention (2003).

The purpose of this study was to determine the comparative effects of the two major disposable prophylaxis angle designs on the market in minimizing risk of disease transmission from spatter. Two disposable prophylaxis angle designs were tested in a *in vitro* comparison laboratory study using a mounted dental manikin with simulated soft tissue, 90° reciprocating disposable prophylaxis angles and 360° unirotational disposable prophylaxis angles, used at 1500, 2000, and 3000 rpm, with fine, medium and coarse prophylaxis paste grits. Under these various conditions the prophylaxis angles were evaluated for spatter production with the use of prophylaxis pastes of various grits to the facial aspects of the mandibular teeth from first molar to first molar in 270 laboratory trials. Biotene® saliva substitute drops were used to simulate natural saliva. Disclosing solution was added to the saliva substitute to visualize the spatter droplets. For each trial, two sheets of white graph paper measuring 54 x 64 inches were attached to a foam board used to collect spatter disbursed during the simulated dental prophylaxis procedures. The foam board, measuring four feet in length and five feet wide, was placed two inches below the dental manikin's chin. Each trial consisted of polishing the facial aspects of 12 synthetic teeth of the dental manikin, with the use of a disclosing solution dyed saliva substitute and a unit of prophylaxis paste (fine, medium or coarse), at preset rpm (1500, 2000 or 3000 rpm) with the 90° reciprocating prophylaxis angle or the traditional 360° unirotational prophylaxis angle. A new prophylaxis angle and new unit of prophylaxis paste was used for each trial. Following each trial, the dental manikin apparatus was thoroughly cleaned and dried.

Outcomes suggest that the traditional 360° unirotational prophylaxis angle generates more spatter than the 90° reciprocating prophylaxis angle in *vitro*. Therefore, the 90° reciprocating prophylaxis angle might reduce client and clinician exposure to pathogenic agents including a host of microorganisms that infect the oral cavity and respiratory system (Harrel & Molinari, 2004). In addition to less spatter production, the 90° reciprocating angle is equally effective in stain removal capability as reported by Lacross (2006). Although the manufacturer reports less heat generation by the 90° reciprocating angle, this claim must be validated in future research studies.

The unirotational design of the traditional prophylaxis angle seems to yield the greatest amount of spatter generation. However, future clinical trials are indicated to determine the amount of spatter produced when these prophylaxis angles are tested with varying amounts of natural saliva present in the oral cavity and slow speed evacuation.

Results revealed no statistically significant difference in the spatter generated by fine, medium, or coarse grit prophylaxis pastes as measured by the number of spatter droplets counted on the graph paper apparatus when using the 90° reciprocating prophylaxis angle. However, results reveal that when using the 360° unirotational prophylaxis angle, the type of prophylaxis paste was a significant factor in the amount of spatter production. Therefore the size of the grit particles in the prophylaxis paste used did affect the amount of spatter generated during the laboratory trials when operating the 360° unirotational prophylaxis angle.

Statistical analysis revealed a significant difference between the amount of spatter produced by 2000, and 3000 rpm with the traditional 360° unirotational prophylaxis angle. Additionally, higher rpm dental handpiece speed generated more spatter. Conversely, no difference in the amount of spatter was produced by 1500, 2000, or 3000 rpm while using the 90° reciprocating prophylaxis angle. The difference in the amount of spatter produced is most likely due to the angle design of the 360° unirotational prophylaxis angle, which generated significantly larger quantities of spatter during each trial. Guignon (2007) suggests that for extrinsic stain removal, dental handpieces should be run at speeds no higher than 3000 rpm. According to Wilkins (2005), typical speeds used during the dental hygiene process of care range from 6000 to 10,000 rpm. Yet Christianson and Bangerter (1984) found that most dental hygienists use approximately 2700 rpm while polishing. Crosstex® recommends using 4000 rpm for optimum results when using the 90° reciprocating prophylaxis angle.

Based on the results of this laboratory study, the following conclusions are presented:

1. The traditional 360° unirotational prophylaxis angle produces more spatter than the 90° reciprocating prophylaxis angle; therefore, use of the 90° reciprocating angle may reduce the potential for disease transmission during polishing procedures as a result of spatter.

2. Spatter production is not affected by the various grit abrasivity levels of the NUPRO® brand prophylaxis paste with the 90° reciprocating prophylaxis angle.

3. Spatter production is affected by the various grit abrasivity levels of the NUPRO® brand prophylaxis paste with the 360° unirotational prophylaxis angle.

4. Spatter is produced with the traditional 360° unirotational prophylaxis angle at 1500, 2000, and 3000 rpm. Additionally, the higher the dental handpiece rpm used, the more spatter generated with the unirotational design of traditional prophylaxis angles.

5. No appreciable spatter is produced by the 90° reciprocating prophylaxis angle regardless of dental handpiece rpm used.

Given the results of this study the following are offered as recommendations for future research studies:

1. Future researchers should consider conducting a clinical trial with use of low-speed evacuation to evaluate spatter production of the 90° reciprocating prophylaxis angle and the 360° unirotational prophylaxis angle.

2. Dental hygienists would benefit from conclusive research that determines the ideal rpm range for effective stain removal and tooth safety.

3. Replication of this study with other brands of prophylaxis paste may yield differing results regarding spatter production.

4. Future studies should explore an *in vitro* comparison of the 90° reciprocating prophylaxis angle and the 360° unirotational prophylaxis angle on heat production during prophylaxis procedures.

Based on the results of this study, the 90° reciprocating prophylaxis angle should be considered an ideal choice for dental hygienists performing routine extrinsic stain removal procedures. The new 90° reciprocating design eliminates spatter and therefore may reduce the potential for disease transmission during polishing procedures as a result of spatter production.

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APPENDIX A

Proposed ANSI/ADA Specification No. 85 – Part 1
Approval date: August 25, 2004

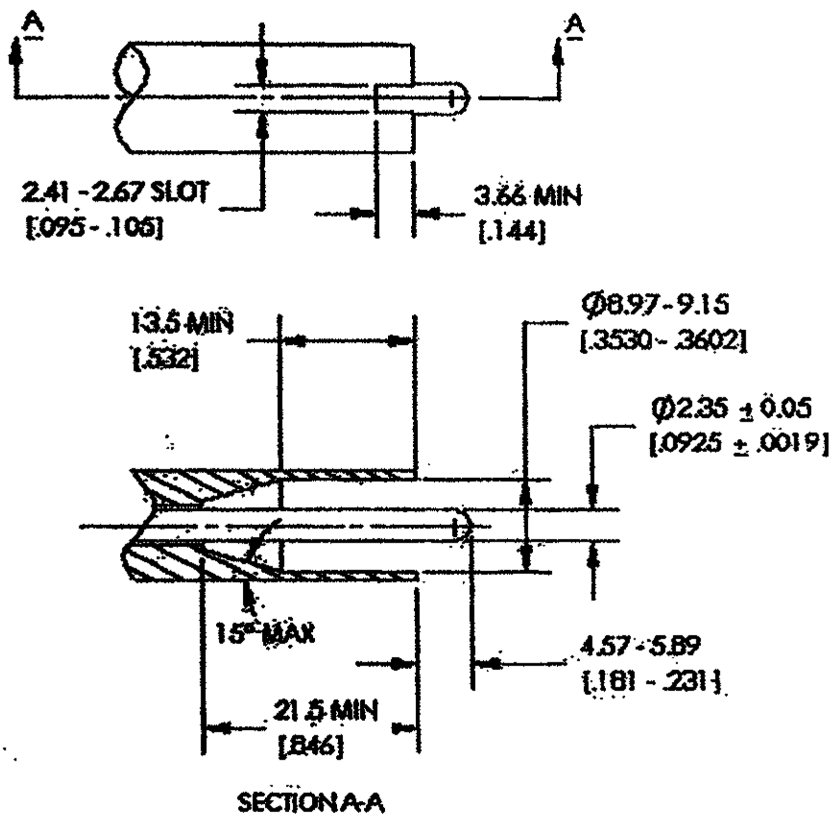
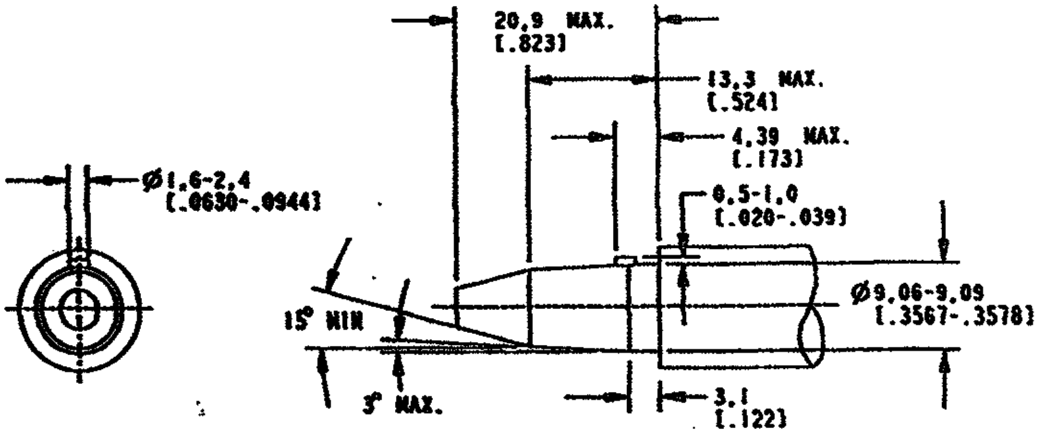


Figure 1. Disposable Prophy Angle – Dimensional Requirements.



NOTES:
1. DIMENSION ARE IN MILLIMETERS(INCH).

Figure 2. Doriot Handpiece Nosecone.

Appendix B

Prophylaxis Angle Specifications

Product Name	Twist Disposable Prophylaxis angle	Young Disposable Prophylaxis angle
Product Description	Reciprocating design disposable prophylaxis angle	Traditional uni-rotational design disposable prophylaxis angle
Manufacturer	Crosstex	Young Dental Mfg Co.
Manufacturer Address and Contact Information	Crosstex Corporate Headquarters 10 Ranick Road Hauppauge, NY 11788 Tel: (631) 582-6777 Toll: Free (888) 276-7783	Young Dental 13705 Shoreline Court East Earth City, MO 63045 (314) 344-0010
Item Number	TPASC	134620
Price	$49.95-59.95 for 100 count bag	$119.00 for 200 count bag
Cost per unit	$0.49-0.59	$0.52
Lot size	100	100
Material	Plastic/Latex free	Plastic/Latex free
Action	An oscillating 90° back and forth motion. Constant contact with tooth surface, no lifting necessary.	A continuous 360° rotation, dabbing motion required to decrease heat production.
Speed	Optimal between 3000 and 4,000 rpm.	Should not operate over 3000 rpm.
Spatter	Less/no spatter (company claim under investigation)	Spatter during use
Heat Production	Less/no heat production (company claim under investigation)	Heat production during use.
Web Page	www.crosstex.com	www.youngdental.com

APPENDIX C

Material Safety Data Sheet

According to 91/155 EC

Printing date 13.10.2003 *Reviewed on 15.04.2003*

1 Identification of substance:

- *Product details:*
- *Trade name: Nupro Prophylaxis Pastes with Fluoride*
- *Application of the substance / the preparation Polishing paste*
- *Manufacturer/Supplier:*
  DENTSPLY DeTrey GmbH
  De-Trey-Str. 1
  D-78467 Konstanz
  GERMANY
  Tel.: +49-7531-583-0
  Fax: +49-7531-583-104
- *Further information obtainable from:*
  - *Department Analytical Research / Research & Development for technical information*
  - *Department Marketing & Sales for distribution of the safety data sheets*

2 Composition/Data on components:

- *Chemical characterization*
- *Description: Mixture of substances listed below with nonhazardous additions.*

Dangerous components:			
CAS: 56-81-5 EINECS: 200-289-5	glycerol		25-50%
CAS: 7681-49-4 EINECS: 231-667-8	sodium fluoride	T; R 25-32-36/38	2.5-10%

- *Additional information For the wording of the listed risk phrases refer to section 16.*

3 Hazard identification

- *Hazard description: not applicable*
- *Information concerning to particular hazards to man and environment*
  The product does not have to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
- *Classification system*
  The classification is according to the latest editions of the EU-lists, and extended by company and literature data.

4 First aid measures

- *General information No special measures required.*
- *After inhalation Void*
- *After skin contact Immediately rinse with water*
- *After eye contact Rinse opened eye for several minutes under running water.*
- *After swallowing If symptoms persist consult doctor.*

5 Fire fighting measures

- *Suitable extinguishing agents Use fire extinguishing methods suitable to surrounding conditions.*

6 Accidental release measures

- *Person-related safety precautions: Wear protective clothing.*
- *Measures for environmental protection: Do not allow to enter sewers/ surface or ground water.*
- *Measures for cleaning/collecting: Pick up mechanically.*

(Contd. on page 2)

Material Safety Data Sheet
According to 91/155 EC

Printing date 13.10.2003 | Reviewed on 15.04.2003

Trade name: Nupro Prophylaxis Pastes with Fluoride

(Contd. of page 1)

· Additional information: No dangerous substances are released.

7 Handling and storage

· Handling Product is intended for dental use only.
· Information for safe handling:
No special measures required.
Observe normal care for working with chemicals.
· Information about fire - and explosion protection: No special measures required.

· Storage
· Requirements to be met by storerooms and receptacles: No special requirements.
· Information about storage in one common storage facility: Not required.
· Further information about storage conditions: Store in cool, dry conditions in well sealed receptacles.

8 Exposure controls and personal protection gear

· Additional information about design of technical facilities: No further data; see item 7.

· Ingredients with limit values that require monitoring at the workplace:	
56-81-5 glycerol	
OEL	10 mg/m3

· Additional information: The lists valid during the making were used as basis.

· Personal protective equipment
· General protective and hygienic measures
The usual precautionary measures are to be adhered to when handling chemicals.
· Respiratory protection: Not required.
· Protection of hands:
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· Material of gloves
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
· Penetration time of glove material
The exact break trough time has to be found out by the manufacturer of the protective gloves and has to be observed.
· Eye protection: Not required.
· Body protection: Protective work clothing.

9 Physical and chemical properties

· General Information	
Form:	Pasty
Colour:	According to product specification
Odour:	Pleasant
· Change in condition	
Melting point/Melting range:	undetermined
Boiling point/Boiling range:	100°C
· Flash point:	160°C
· Ignition temperature:	400°C

(Contd. on page 3)

GB

Material Safety Data Sheet
According to 91/155 EC

Printing date 13.10.2003 — Reviewed on 15.04.2003

Trade name: Nupro Prophylaxis Pastes with Fluoride

(Contd. of page 2)

· Self-igniting:	Product is not selfigniting.
· Danger of explosion:	Product does not present an explosion hazard.
· Explosion limits: Lower:	0.9 Vol %
· Vapour pressure at 20°C:	23 hPa
· Density:	Not determined
· Solubility in / Miscibility with Water:	Insoluble
· pH-value:	9-10

10 Stability and reactivity

- Thermal decomposition / conditions to be avoided: No decomposition if used according to specifications.
- Dangerous reactions No dangerous reactions known
- Dangerous decomposition products: No dangerous decomposition products known

11 [illegible]

- Acute toxicity:
- Primary irritant effect:
- on the skin: No irritant effect.
- on the eye: No irritating effect.
- Sensitization: No sensitizing effects known.
- Additional toxicological information:

The product is not subject to classification according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version.
When used and handled according to specifications, the product does not have any harmful effects to our experience and the information provided to us.

12 Ecological information

- General notes: Generally not hazardous for water.

13 [illegible]

- Product:
- Recommendation Smaller quantities can be disposed of with household waste.

- Uncleaned packaging:
- Recommendation: Disposal must be made according to official regulations.

14 Transport information

· Land transport ADR/RID (cross-border) · ADR/RID class:	-
· Maritime transport IMDG: · IMDG Class: · Marine pollutant:	 - No

(Contd. on page 4)

Material Safety Data Sheet

According to 91/155 EC

Printing date 13.10.2003 | Reviewed on 15.04.2003

Trade name: Nupro Prophylaxis Pastes with Fluoride

(Contd. of page 3)

- Air transport ICAO-TI and IATA-DGR:
- ICAO/IATA Class: -

15 Regulations

- Labelling according to EU guidelines:
  Observe the general safety regulations when handling chemicals
  The product is not subject to identification regulations under EU Directives and the Ordinance on Hazardous Materials (German GefStoffV).
- National regulations
- Technical instructions (air):

Class	Share in %
Wasser	12.0
NK	45.0

- Waterhazard class: Generally not hazardous for water.

[illegible]

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

- Relevant R-phrases
  25 Toxic if swallowed.
  32 Contact with acids liberates very toxic gas.
  36/38 Irritating to eyes and skin.
- Department issuing MSDS: Analytical Research
- Contact: HotLine for urgent technical support: +49-7531-583-333

APPENDIX D

U.S. DEPARTMENT OF LABOR
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
MATERIAL SAFETY DATA SHEET

MSDS REV. 11/03

SECTION I

MANUFACTURERS NAME: *SUNSTAR BUTLER* — EMERGENCY PHONE #: *Rush Poison Control 800-752-7868 Ext. 12*

ADDRESS: *4635 WEST FOSTER AVENUE, CHICAGO, IL 60630*

CHEMICAL NAME & SYNONYMS: *MIXTURE* — TRADE NAME & SYNONYMS: *RED-COTE LIQUID*

CHEMICAL FAMILY: *MIXTURE* — FORMULA: *MIXTURE*

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIONS AND SOLVENTS: *NOT APPLICABLE* — TLV UNITS: *NOT APPLICABLE*

ALLOYS AND METALLIC COATING: *NOT APPLICABLE* — TLV UNITS: *NOT APPLICABLE*

PIGMENTS: *NOT APPLICABLE* — BASE METAL: *NOT APPLICABLE*

CATALYST: *NOT APPLICABLE* — ALLOYDS: *NOT APPLICABLE*

VEHICLE: *NOT APPLICABLE* — METALLIC COATINGS: *NOT APPLICABLE*

SOLVENTS: *NOT APPLICABLE* — FILLER METAL PLUS COATING: *NOT APPLICABLE*

ADDITIVES: *NOT APPLICABLE* — CORE FLUX: *NOT APPLICABLE*

OTHERS: *NOT APPLICABLE* — OTHERS: *NOT APPLICABLE*

HAZARDOUS MIXTURES OR OTHER LIQUIDS, SOLIDS OR GASES: *NOT APPLICABLE*

SECTION III - PHYSICAL DATA

BOILING POINT (°F): *NOT APPLICABLE* — SPECIFIC GRAVITY (H_2O-1): *1.02*

VAPOR PRESSURE (mmHg): *NOT APPLICABLE* — PERCENT, VOLATILE BY VOLUME(%): *NOT AVAILABLE*

VAPOR DENSITY (AIR-1): *NOT APPLICABLE* — EVAPORATION RATE (____-1): *NOT AVAILABLE*

SOLUBILITY IN WATER: *COMPLETE* — APPEARANCE AND ODOR: *NOT APPLICABLE*

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED): *NOT APPLICABLE* — FLAMMABLE LIMITED: *NOT APPLICABLE*

EXTINGUISHING MEDIA: *NOT APPLICABLE*

SPECIAL FIRE FIGHTING PROCEDURES: *NONE* — UNUSUAL FIRE AND EXPLOSION HAZARDS: *NONE*

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: *NOT APPLICABLE*

EFFECTS OF OVER EXPOSURE: *NOT APPLICABLE*

EMERGENCY & FIRST AID PROCEDURES: *IF ACCIDENTALLY TAKEN INTERNALLY IN LARGE AMOUNTS, INDUCE VOMITING, AND SEE A PHYSICIAN*

SECTION VI - REACTIVITY DATA

STABILITY: *UNSTABLE* ____ *STABLE* ✓ — INCOMPATIBILITY (MATERIALS TO AVOID): *NONE*

HAZARDOUS DECOMPOSITION PRODUCTS: *NOT AVAILABLE*

HAZARDOUS POLYMERIZATION: *MAY OCCUR* ____ *WILL NOT OCCUR* ✓ — CONDITIONS TO AVOID: *NONE*

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: *DILUTE WITH WATER AND DETERGENT FOR CLEAN UP*

SPECIFIC WASTE DISPOSAL METHOD: *NORMAL SEWAGE SYSTEM*

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): *NONE REQUIRED* — PROTECTIVE GLOVES: *NOT APPLICABLE*

EYE PROTECTION: *NOT APPLICABLE*

VENTILATION: *LOCAL EXHAUST* — SPECIAL: *NOT APPLICABLE* — MECHANICAL(GENERAL): *NOT APPLICABLE* — OTHER: *NOT APPLICABLE*

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: *DO NOT FREEZE, PLASTIC BOTTLE WILL BREAK*

OTHER PRECAUTIONS: *NOT APPLICABLE*

APPENDIX E

Subject	Angle	Paste	Speed	Score
1	Young	Fine	1500	31
2	Young	Fine	1500	8
3	Young	Fine	1500	23
4	Young	Fine	1500	15
5	Young	Fine	1500	7
6	Young	Fine	1500	23
7	Young	Fine	1500	18
8	Young	Fine	1500	30
9	Young	Fine	1500	25
10	Young	Fine	1500	72
11	Young	Fine	1500	19
12	Young	Fine	1500	32
13	Young	Fine	1500	32
14	Young	Fine	1500	12
15	Young	Fine	1500	28
16	Young	Fine	2000	38
17	Young	Fine	2000	29
18	Young	Fine	2000	32
19	Young	Fine	2000	24
20	Young	Fine	2000	73
21	Young	Fine	2000	67
22	Young	Fine	2000	87
23	Young	Fine	2000	75
24	Young	Fine	2000	35
25	Young	Fine	2000	52
26	Young	Fine	2000	78
27	Young	Fine	2000	81
28	Young	Fine	2000	95
29	Young	Fine	2000	47
30	Young	Fine	2000	70
31	Young	Fine	3000	25
32	Young	Fine	3000	30
33	Young	Fine	3000	43
34	Young	Fine	3000	49
35	Young	Fine	3000	54
36	Young	Fine	3000	36
37	Young	Fine	3000	66
38	Young	Fine	3000	54
39	Young	Fine	3000	61
40	Young	Fine	3000	66
41	Young	Fine	3000	78
42	Young	Fine	3000	40
43	Young	Fine	3000	39
44	Young	Fine	3000	98
45	Young	Fine	3000	15
46	Young	Medium	1500	13
47	Young	Medium	1500	4
48	Young	Medium	1500	21

49	Young	Medium	1500	38
50	Young	Medium	1500	9
51	Young	Medium	1500	10
52	Young	Medium	1500	36
53	Young	Medium	1500	17
54	Young	Medium	1500	18
55	Young	Medium	1500	20
56	Young	Medium	1500	20
57	Young	Medium	1500	27
58	Young	Medium	1500	20
59	Young	Medium	1500	24
60	Young	Medium	1500	20
61	Young	Medium	2000	81
62	Young	Medium	2000	45
63	Young	Medium	2000	35
64	Young	Medium	2000	81
65	Young	Medium	2000	53
66	Young	Medium	2000	90
67	Young	Medium	2000	15
68	Young	Medium	2000	39
69	Young	Medium	2000	66
70	Young	Medium	2000	37
71	Young	Medium	2000	88
72	Young	Medium	2000	33
73	Young	Medium	2000	33
74	Young	Medium	2000	53
75	Young	Medium	2000	65
76	Young	Medium	3000	120
77	Young	Medium	3000	86
78	Young	Medium	3000	52
79	Young	Medium	3000	95
80	Young	Medium	3000	116
81	Young	Medium	3000	118
82	Young	Medium	3000	85
83	Young	Medium	3000	109
84	Young	Medium	3000	126
85	Young	Medium	3000	105
86	Young	Medium	3000	77
87	Young	Medium	3000	83
88	Young	Medium	3000	46
89	Young	Medium	3000	58
90	Young	Medium	3000	24
91	Young	Coarse	1500	29
92	Young	Coarse	1500	11
93	Young	Coarse	1500	25
94	Young	Coarse	1500	26
95	Young	Coarse	1500	18
96	Young	Coarse	1500	12
97	Young	Coarse	1500	17
98	Young	Coarse	1500	33
99	Young	Coarse	1500	16
100	Young	Coarse	1500	28

101	Young	Coarse	1500	19
102	Young	Coarse	1500	22
103	Young	Coarse	1500	20
104	Young	Coarse	1500	4
105	Young	Coarse	1500	15
106	Young	Coarse	2000	27
107	Young	Coarse	2000	40
108	Young	Coarse	2000	18
109	Young	Coarse	2000	22
110	Young	Coarse	2000	15
111	Young	Coarse	2000	14
112	Young	Coarse	2000	21
113	Young	Coarse	2000	28
114	Young	Coarse	2000	13
115	Young	Coarse	2000	38
116	Young	Coarse	2000	42
117	Young	Coarse	2000	8
118	Young	Coarse	2000	22
119	Young	Coarse	2000	28
120	Young	Coarse	2000	26
121	Young	Coarse	3000	70
122	Young	Coarse	3000	97
123	Young	Coarse	3000	61
124	Young	Coarse	3000	20
125	Young	Coarse	3000	68
126	Young	Coarse	3000	44
127	Young	Coarse	3000	59
128	Young	Coarse	3000	95
129	Young	Coarse	3000	114
130	Young	Coarse	3000	105
131	Young	Coarse	3000	28
132	Young	Coarse	3000	36
133	Young	Coarse	3000	106
134	Young	Coarse	3000	45
135	Young	Coarse	3000	17
136	Twist	Fine	1500	0
137	Twist	Fine	1500	0
138	Twist	Fine	1500	0
139	Twist	Fine	1500	0
140	Twist	Fine	1500	0
141	Twist	Fine	1500	0
142	Twist	Fine	1500	0
143	Twist	Fine	1500	1
144	Twist	Fine	1500	0
145	Twist	Fine	1500	3
146	Twist	Fine	1500	1
147	Twist	Fine	1500	0
148	Twist	Fine	1500	0
149	Twist	Fine	1500	0
150	Twist	Fine	1500	1
151	Twist	Fine	2000	0
152	Twist	Fine	2000	0

153	Twist	Fine	2000	0
154	Twist	Fine	2000	0
155	Twist	Fine	2000	1
156	Twist	Fine	2000	0
157	Twist	Fine	2000	0
158	Twist	Fine	2000	0
159	Twist	Fine	2000	0
160	Twist	Fine	2000	0
161	Twist	Fine	2000	1
162	Twist	Fine	2000	0
163	Twist	Fine	2000	2
164	Twist	Fine	2000	1
165	Twist	Fine	2000	0
166	Twist	Fine	3000	2
167	Twist	Fine	3000	0
168	Twist	Fine	3000	0
169	Twist	Fine	3000	0
170	Twist	Fine	3000	0
171	Twist	Fine	3000	0
172	Twist	Fine	3000	0
173	Twist	Fine	3000	1
174	Twist	Fine	3000	3
175	Twist	Fine	3000	0
176	Twist	Fine	3000	0
177	Twist	Fine	3000	0
178	Twist	Fine	3000	0
179	Twist	Fine	3000	0
180	Twist	Fine	3000	0
181	Twist	Medium	1500	0
182	Twist	Medium	1500	0
183	Twist	Medium	1500	0
184	Twist	Medium	1500	1
185	Twist	Medium	1500	0
186	Twist	Medium	1500	0
187	Twist	Medium	1500	0
188	Twist	Medium	1500	0
189	Twist	Medium	1500	0
190	Twist	Medium	1500	0
191	Twist	Medium	1500	0
192	Twist	Medium	1500	0
193	Twist	Medium	1500	0
194	Twist	Medium	1500	0
195	Twist	Medium	1500	0
196	Twist	Medium	2000	0
197	Twist	Medium	2000	3
198	Twist	Medium	2000	0
199	Twist	Medium	2000	0
200	Twist	Medium	2000	0
201	Twist	Medium	2000	0
202	Twist	Medium	2000	0
203	Twist	Medium	2000	0
204	Twist	Medium	2000	1

205	Twist	Medium	2000	0
206	Twist	Medium	2000	0
207	Twist	Medium	2000	1
208	Twist	Medium	2000	0
209	Twist	Medium	2000	1
210	Twist	Medium	2000	0
211	Twist	Medium	3000	1
212	Twist	Medium	3000	0
213	Twist	Medium	3000	1
214	Twist	Medium	3000	0
215	Twist	Medium	3000	0
216	Twist	Medium	3000	0
217	Twist	Medium	3000	0
218	Twist	Medium	3000	0
219	Twist	Medium	3000	0
220	Twist	Medium	3000	0
221	Twist	Medium	3000	0
222	Twist	Medium	3000	0
223	Twist	Medium	3000	1
224	Twist	Medium	3000	0
225	Twist	Medium	3000	2
226	Twist	Coarse	1500	0
227	Twist	Coarse	1500	0
228	Twist	Coarse	1500	1
229	Twist	Coarse	1500	0
230	Twist	Coarse	1500	2
231	Twist	Coarse	1500	0
232	Twist	Coarse	1500	0
233	Twist	Coarse	1500	2
234	Twist	Coarse	1500	0
235	Twist	Coarse	1500	0
236	Twist	Coarse	1500	1
237	Twist	Coarse	1500	0
238	Twist	Coarse	1500	1
239	Twist	Coarse	1500	0
240	Twist	Coarse	1500	0
241	Twist	Coarse	2000	2
242	Twist	Coarse	2000	1
243	Twist	Coarse	2000	0
244	Twist	Coarse	2000	0
245	Twist	Coarse	2000	1
246	Twist	Coarse	2000	0
247	Twist	Coarse	2000	0
248	Twist	Coarse	2000	0
249	Twist	Coarse	2000	0
250	Twist	Coarse	2000	0
251	Twist	Coarse	2000	1
252	Twist	Coarse	2000	2
253	Twist	Coarse	2000	0
254	Twist	Coarse	2000	0
255	Twist	Coarse	2000	1
256	Twist	Coarse	3000	0

257	Twist	Coarse	3000	0
258	Twist	Coarse	3000	0
259	Twist	Coarse	3000	0
260	Twist	Coarse	3000	3
261	Twist	Coarse	3000	0
262	Twist	Coarse	3000	1
263	Twist	Coarse	3000	0
264	Twist	Coarse	3000	0
265	Twist	Coarse	3000	0
266	Twist	Coarse	3000	0
267	Twist	Coarse	3000	0
268	Twist	Coarse	3000	1
269	Twist	Coarse	3000	0
270	Twist	Coarse	3000	0

CURRICULUM VITAE October 6, 2006

NAME: Kelly Schulz

EDUCATION:

Old Dominion University 2004
Norfolk, VA
Graduated Magna Cum Laude
Bachelor of Science in Dental Hygiene

EXPERIENCE:

Private Practice
2004- Present Dental Hygienist (Periodontal and General Dentistry) Part-time

TEACHING:

2006- Teaching Internship: DNTH 417 Dental Hygiene Theory V. Responsibilities include: Create 5 lesson plans, power point presentations and test questions. Team teach lecture multiple lectures to senior dental hygiene students. Grade assignments and proctor exams.

GRANTS APPLIED FOR:

2006 Darby, M. (Principal Investigator) **Schulz, K.M.** In Vitro Comparison of Traditional Disposable Prophylaxis Angles versus TWIST2IT Disposable Prophylaxis Angles on Spatter during Rubber Cup Polishing. American Dental Hygienists' Association, $4287.78.

RESEARCH IN PROGRESS:

Bauman D., Schulz KM. In Vitro Comparison of Traditional Disposable Prophylaxis Angles versus TWIST2IT Disposable Prophylaxis Angles on Spatter during Rubber Cup Polishing. Old Dominion University.

MEMBERSHIP IN PROFESSIONAL SOCIETIES:

2002- present	Student American Dental Hygienists' Association (SADHA)

COMMUNITY SERVICE:

2003	Volunteer- Mission of Mercy Project / Day of dental access. Old Dominion University. Provided Non-surgical Periodontal Therapy.
2003	Volunteer- Dental Health Education- Educare Children's Center. Provided oral hygiene education.
2004	Volunteer- Chesapeake Care Free Clinic. Exposed dental radiographs, Provided Non-surgical Periodontal Therapy, provided oral hygiene instruction.
2004	Volunteer- Dental Health Education at Chesapeake senior center, Chesapeake, Virginia. Provided oral hygiene education.
2004	Volunteer- "Give Kids a Smile" Oral Health Screening and Sealant Project, Old Dominion University School of Dental Hygiene and Tidewater Dental Association. Exposed dental radiographs, placed dental sealants and provided oral hygiene instruction.
2004	Volunteer- Dental Health Education- John Tyler Elementary School. Portsmouth, Virginia. Provided oral hygiene education.
2004	Volunteer- Dental Health Education- Christopher Farms Elementary School, Virginia Beach, Virginia. Provided oral hygiene education.
2005	Volunteer- Dental Health Education- Christopher Farms Elementary School. Virginia Beach, Virginia. Provided oral hygiene education.
2006	Volunteer- Dental Health Education- Christopher Farms Elementary School. Virginia Beach, Virginia. Provided oral hygiene education.
2007	Volunteer- Dental Health Education- Christopher Farms Elementary School. Virginia Beach, Virginia. Provided oral hygiene education.