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- TABLE OF CONTENTS -

1 Editorial Message

2 The Effectiveness of Alibutbut (*Tabernaemontana pandacaqui* Poir.) Leaf Extract Against *Streptococcus mutans*: An in vitro experimental study

Marie Arlene Christine Tolentino Valerio, DMD, MHPed¹; Manuel B. Balbontin II²;

Febe Sofia G. Confesor²; Gerielou Marie G. Gonzaga²; Anne Dominique S. Nacionales²;

Bram Johnlee C. Pimentel²; Margaux Lein S. Villaruel²

¹National Teacher Training Center for the Health Professions, University of the Philippines, Manila, Philippines

²College of Dentistry, Iloilo Doctors, Iloilo City, Philippines

8 Microwave Irradiation as a Tool for Deactivating the Bacterial Infectivity of *Pseudomonas aeruginosa*

H.J. Angeles¹; C. Baccay¹; M.R.K. Baterzal¹; K.A. Columbres¹; H.D. Dela Cruz¹; P.D. Jimenez¹; Y. Silva¹; B. Yandoc¹; Dr. H. Hallare¹

¹School of Dentistry, Centro Escolar University, Manila, Philippines

16 Comparative Study on the Efficiency of a Manual Periodontal Probe and a Pressure-sensitive Probe in Measuring Probing Pocket Depths

Ma. Celina U. Garcia, DDM¹; Bianca P. Tumang, DDM¹; Maria Bernadette G. Ramos, DDM¹

¹College of Dentistry, University of the Philippines Manila, Philippines

25 A Single-Blinded Study on the Effects of Hydroethanolic Extract from Ginger (*Zingiber officinale* Roscoe) Rhizomes on Salivary Flow Rate, pH, and Buffering Capacity

E.J. Alingarog¹; J. Belgica¹; C.V. Caluya¹; K.F. Declasin¹; B.A. Estabaya¹; F.L. Estonactoc¹; B.D. Jurada¹; L.A.J. Lequiron¹; J.R. Reyes¹; H.R. Hallare¹

¹School of Dentistry, Centro Escolar University, Manila, Philippines

30 The Philippine Dental Association, Inc.
Dental Caries Preventive and Interceptive Management
Evidence-based Guidelines for the General Practicing Dentists
Adapted from American Dental Association (ADA), (2013/2018/2024),
and Scottish Intercollegiate Guidelines Network, (2014) Guidelines

Marie Arlene Christine T. Valerio, DMD, MHPed¹; Mya Win Hnit, MBBS, MSc.CM-FM²;

Alvin M. Laxamana, DMD, PhD³; Michelle Sunico-Segarra, DDM, MOH, PhD⁴;

Maria Jacinta Rosario H. Romero, DDM, PhD⁴; Aaron Paul T. Baliga, MSc⁵

¹Centro Escolar University, Manila, Philippines

²Myanmar Academy of Family Physicians, Myanmar

³University of Perpetual Help, Laguna, Philippines

⁴University of the Philippines, Manila, Philippines

⁵Philippine Normal University, Manila, Philippines

42 Instructions to Authors

EDITORIAL MESSAGE

Bridging Science and Practice in Contemporary Dentistry

Dr. Alvin M. Laxamana

Editor-in-Chief, Journal of the Philippine Dental Association, Inc.

As we present the third issue of the *Journal of the Philippine Dental Association, Inc.*, we are reminded that dentistry exists at the intersection of science and service. While scientific discoveries continue to shape our profession, their true value lies in how they are translated into patient care. Bridging science and practice remains essential in advancing oral health and strengthening the quality of care we provide.

Clinical excellence is achieved when practice is guided by evidence and informed by experience. Every patient encounter offers an opportunity to apply scientific knowledge with care, precision, and purpose. As innovations continue to emerge, the responsibility of the Filipino dentist is not simply to adopt what is new, but to discern what is meaningful and beneficial to patients.

Lifelong learning therefore remains fundamental to professional growth. Through scholarly engagement and continued education, we sustain the standards of our profession and ensure that our patients benefit from current knowledge. The *Journal of the Philippine Dental Association* continues to serve as a platform for scientific exchange, professional development, and the advancement of evidence-based dentistry.

At the same time, we remain hopeful in strengthening research within the profession. Important questions often arise from everyday clinical practice, and meaningful contributions to dental knowledge may begin with observation, inquiry, and a desire to improve patient outcomes. We encourage clinicians, educators, and young professionals to continue contributing to the growing body of oral health research.

As this issue marks my final message as Editor-in-Chief, I express my sincere gratitude for the opportunity to serve the profession through this journal. I remain hopeful that the *JPDA* will continue to foster scholarship, inspire inquiry, and uphold excellence in Philippine dentistry.

May we continue to advance a profession where science informs practice, learning remains lifelong, and patient-centered care endures at the heart of what we do.

Mabuhay ang agham. Mabuhay ang dentistriya. Mabuhay ang JPDA.

About the Author

Dr. Alvin M. Laxamana served as President of the Philippine Dental Association (PDA) in 2020–2021. He is currently an Associate Professor and Chief of Clinics at the College of Dentistry, University of Perpetual Help System Laguna (UPHSL), where he also serves as a member of the Ethics Review Board under the University Research Center for Allied Medical Programs. He is a Visiting Faculty member at the School of Dentistry, Centro Escolar University Manila, and chairs the Commission on Dental Education of the Asia Pacific Dental Federation–Asia Pacific Regional Organization (APDC–APRO).

Dr. Laxamana is a Fellow of the International College of Dentists, Islands of the Philippines Section, and a Founding Member of the Philippine Association for Dental Research (PADR). He holds a Master's degree in Educational Management and has completed substantial academic units in Public Health at the University of the Philippines Manila.

The Effectiveness of Alibutbut (*Tabernaemontana pandacaqui* Poir.) Leaf Extract Against *Streptococcus mutans*: An in vitro experimental study

Marie Arlene Christine Tolentino Valerio, DMD, MHPed¹

Manuel B. Balbontin II²

Anne Dominique S. Nacionales²

Febe Sofia G. Confesor²

Bram Johnlee C. Pimentel²

Gerielou Marie G. Gonzaga²

Margaux Lein S. Villaruel²

¹National Teacher Training Center for the Health Professions, University of the Philippines, Manila, Philippines

²College of Dentistry, Iloilo Doctors, Iloilo City, Philippines

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ABSTRACT

Dental caries remains one of the most prevalent chronic conditions globally. This is primarily driven by *Streptococcus mutans* through biofilm formation and acid production, leading to destruction of tooth surfaces. While synthetic antimicrobials and traditional prevention methods are widely utilized, rising antimicrobial resistance and safety concerns have shifted research focus toward plant-based alternatives. This study evaluated the antimicrobial efficacy of Alibutbut (*Tabernaemontana pandacaqui*), a medicinal plant native to the Philippines, against *S. mutans*. Employing a posttest-only control group design, antimicrobial activity was assessed using the agar well diffusion method at extract concentrations of 25%, 50%, 75%, and 100%. Chlorhexidine, fluoride varnish, and penicillin served as positive controls, while distilled water was used as the negative control. Antimicrobial efficacy was determined by measuring the zones of inhibition, and data were statistically analyzed using one-way ANOVA and Welch's ANOVA. The results revealed that the antimicrobial activity of *T. pandacaqui* leaf extract is dose-dependent. These findings suggest that Alibutbut leaf extract holds strong potential as a natural, plant-based antimicrobial agent in dental care, offering a viable alternative to synthetic compounds.

Keywords: Dental caries, *Streptococcus mutans*, Alibutbut

INTRODUCTION

Oral health remains a major global public health concern, with dental caries persisting as the most prevalent chronic condition worldwide, affecting an estimated 2.5 billion people with untreated decay in permanent teeth (World Health Organization, 2022).

High sugar consumption combined with poor oral hygiene creates an optimal environment for *Streptococcus mutans* to form a pathogenic biofilm; this matrix promotes localized acid production, leading to the demineralization of the tooth surface known as dental caries (Babaeekhou et al., 2020; Spatafora et al., 2024).

Although fluoride remains the gold standard for dental caries prevention, its use in young children is limited by the

risk of dental fluorosis (Walsh et al., 2010; Lubojanski et al., 2023). Similarly, while chlorhexidine has gained popularity as an antimicrobial adjunct, its prolonged use raises concerns regarding antimicrobial resistance, mirroring challenges faced by conventional antibiotics (Yang et al., 2024; Diaz et al., 2015). Beyond these clinical limitations, synthetic interventions often suffer from high costs, limited availability, and poor accessibility in remote or underserved areas. Consequently, these therapeutic and logistical challenges have driven research toward investigating plant-based alternatives as viable, sustainable options for oral health care (Tzimas et al., 2024).

The global utilization of medicinal plants for managing oral infections is well-documented (Kumar et al., 2021), with ethnomedicine identifying numerous species with potential antimicrobial activity (Ashraf et al., 2023). Although indigenous

communities in the Philippines have historically used over 1,500 medicinal plant species (Dapar et al., 2020), many still lack formal empirical validation for their pharmacological properties. Among these is *Tabernaemontana pandacaqui* Poir. (Apocynaceae), known as Pandakaki-puti or Alibutbut, a traditional remedy for fever, gastrointestinal distress, and infection. The therapeutic properties of *T. pandacaqui* are attributed to bioactive compounds such as tannins, alkaloids, and flavonoids (Galanta et al., 2022). While flavonoids and tannins are known to exert antimicrobial effects against oral pathogens (Tzimas et al., 2024), scarce literature has specifically investigated Alibutbut leaf extract against *Streptococcus mutans*.

To address this gap, this study aimed to evaluate the plant's antimicrobial efficacy against *S. mutans*. It also compared its effect in different concentrations, 25%, 50%, 75%, and pure 100% concentration, with a positive control (chlorhexidine, penicillin, and fluoride) and a negative control (distilled water).

METHODOLOGY

This study used an in vitro experimental design to assess the possible antimicrobial effect of Alibutbut leaf extract against *S. mutans*. The main outcome was the zone of inhibition on culture plates using the Agar Well Diffusion method.

Materials and Methods

Experimental Instrumentation and Reagents

All primary experimental procedures were performed within a Class II biosafety cabinet to maintain strict aseptic conditions. Media preparation and thermal processing steps utilized a regulated water bath, while dry laboratory tools were sterilized in a hot air oven. Glassware, petri dishes, and associated utility tools underwent autoclave sterilization at 121°C and 15 psi for 15 minutes.

Quantitative measurements of botanical powders and chemical reagents were determined using an analytical laboratory scale. Liquid volumes were manipulated using high-precision micropipettes, and bacterial suspensions were homogenized via a vortex mixer. The primary growth medium utilized was Mueller-Hinton agar (MHA). The experimental design incorporated 95% ethanol as the extraction solvent, 0.20% chlorhexidine, fluoride varnish, and penicillin as positive controls, and sterile distilled water as the negative control.

Plant Collection and Extraction Process

Whole Alibutbut (*Tabernaemontana pandacaqui*) specimens were harvested from Cabatuan, Iloilo, Philippines, and taxonomically authenticated at the local Office of the Municipal Agriculturist. A 500 g sample of harvested leaves was thoroughly washed with clean water and air-dried in a cool, dark environment for 14 days. The dried leaves were subsequently pulverized into a fine powder using a laboratory blender.

A 150 g portion of the resulting powder was macerated in 450 mL of 95% ethanol (1:3 w/v ratio) for 72 hours, with periodic manual agitation to maximize phytochemical extraction. Following maceration, the mixture was filtered three times through Whatman No. 1 filter paper to ensure purity. The collected filtrate was concentrated using a rotary evaporator unit at 40°C to eliminate residual solvent. The resulting crude leaf extract was transferred to a sterile container and stored at 4°C until further experimental use.

Preparation of Culture Media

Mueller-Hinton agar was prepared using an analytical balance and a water bath in strict accordance with the manufacturer's instructions. The medium was sterilized via autoclaving at 121°C for 15 minutes, poured into sterile petri dishes, and allowed to solidify. To remove excess surface moisture and maintain sterility, the solidified agar plates underwent a brief drying phase in a hot air oven.

Antimicrobial Activity Assays

A pure culture of *Streptococcus mutans* was obtained from the Philippine National Collection of Microorganisms. All inoculation and testing phases were conducted within a Class II biosafety cabinet to ensure strict aseptic conditions (World Health Organization, 2025). The microbial suspension was uniformly seeded onto the MHA surfaces using sterile cotton applicators.

The agar well diffusion method was utilized to determine antimicrobial activity (Oussaaïd et al., 2021). Equidistant wells measuring approximately 6–8 mm in diameter were punched into each agar plate.

- **Initial Assay:** Ten plates were inoculated using agar-isolated colonies, and another ten plates were prepared using a broth culture inoculum. Each plate contained four wells assigned to receive the respective test solutions: Alibutbut leaf extract at concentrations of 25%, 50%, 75%, and 100%, alongside 0.20% chlorhexidine as a positive control and distilled water as a negative control.
- **Comparative Control Assays:** Supplemental assays were performed to evaluate additional positive controls against the 100% extract concentration and the negative control. In one set consisting of three broth-inoculated plates, the wells were filled with 0.20% chlorhexidine, 100% Alibutbut extract, and distilled water. In a parallel group, fluoride varnish was integrated alongside chlorhexidine, the 100% extract, and distilled water. Concurrently, penicillin susceptibility was evaluated on the same plate configurations utilizing the Kirby-Bauer disk diffusion method.

All experimental and control plates were incubated at 37°C for 12 hours. Following incubation, the plates were inspected for bacterial growth and the presence of clear zones of inhibition.

Data Gathering Procedure

The zones of inhibition surrounding each well and disk were measured manually. To ensure geometric precision and reproducibility, three distinct diameter measurements, horizontal, vertical, and diagonal, were recorded for each zone using a standard metric caliper, and the mean value was calculated for statistical analysis (Kermani et al., 2020).

Data Analysis Procedure

Statistical analyses were performed to compare the zones of inhibition across the various concentrations of Alibutbut (*Tabernaemontana pandaciqui*) extract and the respective control groups. A standard one-way Analysis of Variance (ANOVA) was utilized for group comparisons, supplemented by Welch's ANOVA to account for potential heteroscedasticity (unequal variances) within the dataset. For all statistical tests, the level of significance was pre-established at $\alpha = 0.05$ ($p < 0.05$) to determine statistically significant differences between the experimental and control groups (Sethi, 2020).

RESULTS AND ANALYSIS

Inferential Analysis

To assess the antimicrobial effect of Alibutbut leaf extract, a one-way ANOVA was performed comparing the zones of inhibition across different extract concentrations and control groups against *Streptococcus mutans*. The analysis demonstrated significant variations in inhibition zone diameters among the treatment groups ($p < 0.05$). The descriptive statistics, detailing the mean and standard deviation for each experimental concentration, are presented in Table 1.

Table 1 showed that 100% leaf extract exhibited the highest mean zone of inhibition with 22.4 mm, followed by 75% (18.8 mm), 50% (13.9 mm), and 25% with 11.1 mm.

Concentration	N	Zone of Inhibition	
		M	SD
25%	5	11.15	0.80
50%	5	13.9	1.17
75%	5	18.8	1.10
100%	5	22.4	0.64

Note: M and SD represent mean and standard deviation, respectively.

Table 1. Descriptive statistics for the zone of inhibition (mm) for varying leaf concentration

Treatment	N	Zone of Inhibition	
		Median	SD
Chlorhexidine	5	19.7	0.43
Pure Extract	5	21.7	0.78
Distilled Water	5	0.0	0.0
Fluoride	3	11.4	0.51
Penicillin	2	0.0	0.0

Note: M and SD represent mean and standard deviation, respectively.

Table 2. Descriptive statistics for the zone of inhibition (mm) in terms of treatment

Tukey's HSD Test for multiple comparisons found that the mean measurement of the zone of inhibition value was significantly different in all the concentrations of the leaf extract, 25% ($p = .001$), 50% ($p = .001$), 75% ($p = .001$) and 100% ($p = .001$). Moreover, increasing the concentration of the leaf extract can induce antimicrobial activity against the *S. mutans*. Specifically, these results suggest that Alibutbut leaf extract has potential antimicrobial activity against *Streptococcus mutans*.

Antimicrobial Efficacy

As summarized in Table 2, the pure Alibutbut leaf extract elicited the highest zone of inhibition against *S. mutans*, surpassing the 19.7 mm zone produced by chlorhexidine. Minimal activity was observed for fluoride varnish (11.4 mm), whereas penicillin and distilled water showed no inhibitory effects.

Levene's test was used to check the homogeneity of variance. Because Levene's test indicated unequal variances across groups, a robust Welch's ANOVA was implemented. The result shows variance was not equal, $p = .001$. Welch's ANOVA was used to compare the effect of Alibutbut leaf extract against *Streptococcus mutans* with different treatments. Mean and standard deviation is presented in Table 2.

Welch's ANOVA shows a statistically significant difference on mean zone of inhibition at .05 level, $F(4,4.79) = 1056$, $p = .001$. Games-Howell Post-Hoc Test for multiple comparisons shows that the mean zone of inhibition of pure extract was significantly different compared to chlorhexidine ($p = .015$). Mean zone of inhibition of pure extract was also significantly different from distilled water ($p = .001$), fluoride ($p = .001$) and penicillin ($p = .001$).

These data strongly support the therapeutic potential of Alibutbut leaf extract as an alternative anti-cariogenic agent.

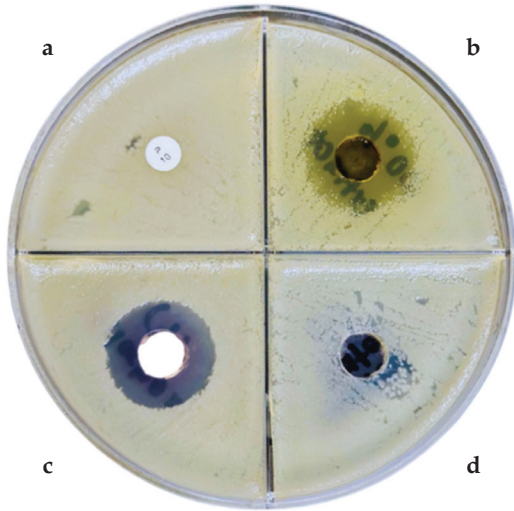


Figure 1. Zone of Inhibition of a) Penicillin b) pure extract
c) Chlorhexidine d) distilled water

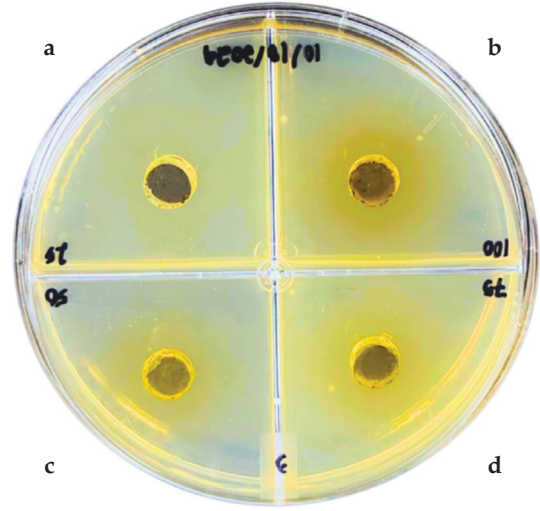


Figure 2. Zone of Inhibition of a) fluoride b) pure extract
c) Chlorhexidine d) distilled water

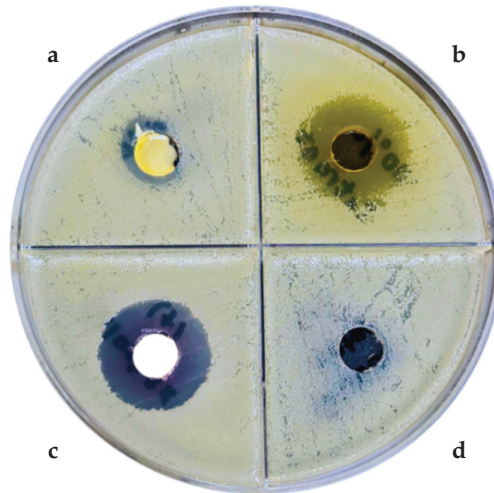


Figure 3. Zone of Inhibition of a) 25% b) 100% c) 50% d) 75%

DISCUSSION

The primary objective of this study was to evaluate the antimicrobial efficacy of Alibutbut (*Tabernaemontana pandacaqui*) leaf extract against *Streptococcus mutans*, focusing on concentration-dependent variations and comparative performance against conventional dental controls. Utilizing the standard agar well diffusion method—a well-established assay where clear zones of inhibition directly correlate with microbial growth inhibition (Reco, 2020)—our findings confirmed that *T. pandacaqui* possesses potent anti-cariogenic properties.

A key finding of this research is the clear dose-dependent nature of the plant's antimicrobial activity. As the extract concentration increased, the mean zone of inhibition expanded significantly, rising from 11.1 mm at a 25% concentration to a peak of 22.4 mm at 100%. The omnibus ANOVA confirmed that these variations across concentrations were statistically significant,

indicating that higher doses provide a greater concentration of active phytochemicals. This dose-dependent behavior aligns with previous literature on plant-based antimicrobials, which indicates that increased concentrations of bioactive secondary metabolites—specifically alkaloids, flavonoids, and tannins—significantly enhance bacterial growth inhibition (Vaou, 2021; Zouine et al., 2024).

Inferential comparisons between the pure (100%) extract and conventional treatments provided critical insights into its relative efficacy. Games-Howell post-hoc testing revealed that the pure Alibutbut extract elicited a significantly larger mean zone of inhibition than distilled water ($p < 0.001$), penicillin ($p < 0.001$), fluoride varnish ($p < 0.001$), and notably, chlorhexidine ($p = 0.015$). While chlorhexidine and fluoride varnish demonstrated their documented baseline inhibitory activities, the superior performance of the pure extract underscores its

aggressive action against *S. mutans*. Conversely, the absolute lack of an inhibitory zone around the distilled water and penicillin groups serves as a reliable negative baseline, verifying that *S. mutans* was highly resistant to the antibiotic variant used under these experimental conditions while validating the active nature of the botanical compounds (Tabugo et al., 2025).

Collectively, these outcomes successfully satisfy the study's core objectives, positioning Alibutbut leaf extract as a highly promising, naturally derived alternative to synthetic compounds in dental care.

In conclusion, this study demonstrates that Alibutbut leaf extract represents a powerful, bio-sustainable alternative to conventional dental agents in combating *Streptococcus mutans*. Leveraging the regional abundance of this indigenous plant in the Philippines provides an economically sustainable opportunity to develop accessible oral care solutions for remote populations. To bridge the gap between this discovery and clinical practice, future investigations must focus on optimizing the extraction yield, identifying specific active fractions, and designing stable clinical formulations suitable for commercial dental applications.

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Microwave Irradiation as a Tool for Deactivating the Bacterial Infectivity of *Pseudomonas aeruginosa*

H.J. Angeles¹
P.D. Jimenez¹

C. Baccay¹
Y. Silva¹

M.R.K. Baterzal¹
B. Yandoc¹

K.A. Columbres¹
H. Hallare¹

H.D. Dela Cruz¹

¹School of Dentistry, Centro Escolar University, Manila, Philippines

ABSTRACT

Sterilization of dental instruments is an indispensable step in delivering safe and quality oral health services to patients. While current sterilization techniques such as autoclave show effectiveness in killing bacteria, these techniques raise concerns on accessibility, cost-effectiveness, and increase in hazardous waste. This study explores the use of microwave irradiation as an alternative method to deactivate *Pseudomonas aeruginosa*, a bacterium that poses a risk in dental settings.

The research aimed to determine the optimal microwave exposure time to reduce bacterial infectivity, comparing 2, 3, and 5-minute durations. The researchers utilized the Semi-quantitative Scoring in approximating the colonies present in each of the plates and categorizing them into “Mild”, “Moderate”, and “Heavy” based on the bacterial growth. The findings indicate that microwave irradiation can effectively reduce *P. aeruginosa* growth, with 5 minutes of exposure showing the most significant decrease in bacterial viability.

The Chi-square test of independence demonstrates a significant relationship between exposure time and bacterial growth, suggesting that microwave irradiation is a potential alternative sterilization method in dental practices. In addition, the Chi-square test of independence comparing microwave and autoclave shows that there is no significant difference in the effectiveness in deactivating the infectivity of *P. aeruginosa* as the p-value went beyond the traditional alpha value.

The study supported its use in dentistry as an alternative to conventional methods, especially in reducing bacterial infectivity of *Pseudomonas aeruginosa* and minimizing the risk of cross-infection in clinical settings.

Keywords: *Pseudomonas aeruginosa*, Microwave, Chi-square, Semi quantitative, bacterial viability

INTRODUCTION

Dental sterilization is a crucial aspect of maintaining a safe and hygienic dental practice. The methods that have been used for many years are autoclave sterilization, dry heat method and chemical vapor method. Although they are effective, they can be expensive, time-consuming and complicated to perform. Microwave sterilization is a relatively new technology that has advantages such as time and energy savings, and the ability

to better penetrate market accessibility. Tools made of specific metals often need to be maintained in order to prevent corrosion when disinfecting them using traditional sterilization techniques like autoclaves. By increasing the cost of ownership and driving up dental supply costs by requiring the frequent replacement of expensive instruments, this corrosion causes major problems to dental practices overall.

Most of the conventional sterilization methods — chemical sterilants or ethylene oxide — emit toxic emissions and go through immense waste management techniques, which are harmful to the environment. Unlike traditional sterilizers that require high energy consumption and lead to pollution, microwave sterilization consumes less energy and produces little waste, offering cleaner processes. This process not only minimizes the emission of hazardous materials, but also reduces its ecological impact compared to conventional sterilization methods. However, exploring the sustainability of these strategies reinforces that environmentally-friendly practices must be considered in dentistry.

One significant hazard to the security of health care is infections people develop throughout or right after treatment for a different condition. Health related infections (HAIs) are contagious in healthcare settings such as hospitals, ambulatory surgical centers, end-stage renal disease institutions and long-term care facilities. WHO states that HAIs can be triggered due to virus, fungus, bacteria or other rare pathogens.

Pseudomonas aeruginosa, the most prominent among *pseudomonas*, can cause infections ranging from UTI and cellulitis to more chronic conditions such as otitis externa and multiple organ dysfunction syndrome, and is most commonly contracted by patients with cystic fibrosis (CF) (Sathe, et al., 2023). It still causes a major disease and death in hospitals and community settings, where infection is profound to vulnerable populations such as the critically ill patients, immunocompromised individuals and the very young and elderly even after all the advancements made by health science. Discovered in 1882 by French pharmacist Carle Gessard, *P. aeruginosa* eventually became an important hospital and intensive care unit pathogen in overcrowded facilities. *P. aeruginosa* have both intrinsic and acquired resistance to many antimicrobial agents and are now an important cause of nosocomial infection worldwide (Wilson & Pandey, 2023). Strains of *P. aeruginosa* are known to be highly adaptive and possess high capacity of resistance to most antibiotics, which makes its eradication increasingly difficult throughout the years. (Pang, et al., 2019).

P. aeruginosa remains a serious public health threat due to its rapid spread and increasing virulence and antimicrobial resistance. In the Philippines, *P. aeruginosa* is the most common etiological agent in hospital-acquired pneumonia cases. In addition, *Pseudomonas* spp. were the second most common pathogen isolated from device-associated hospital acquired-infections in a study conducted across 9 intensive care units in three Philippine hospitals. Between 2010 and 2014, the Philippine Antimicrobial Resistance Surveillance Program (ARSP) reported increasing resistance rates to antibiotics used to treat *P. aeruginosa* infections such as carbapenems and extended-spectrum cephalosporins (Chilam et al., 2020).

The oral cavity harbors a multitude of commensal flora, which may constitute a repository of antibiotic resistance determinants. In the oral cavity, bacteria form biofilms, and this facilitates the acquisition of antibiotic-resistance genes through horizontal gene transfer. It can be a reservoir of *P. aeruginosa* in patients with periodontitis, especially in debilitated patients, mainly in those hospitalized in intensive care units and exposed to invasive procedures. Patients with chronic diseases, such as chronic renal disease and cystic fibrosis, are also exposed to a high risk of *P. aeruginosa* oral infection (Eduardo, et al., 2019).

According to the study by Schelstraete et al., neither home environment nor other patients are important sources of *P. aeruginosa* infection. One possible source could be aerosol exposition of contaminated water during dental treatment. Transmission of microbial pathogens to patients from water in dental chair units (DCUs) has been a concern for many years. In the early 1980s, a German study revealed *P. aeruginosa* in 74% (29 out of 39 patients) of the investigated DCUs in private dental practices (Barben & Schmid, 2008). Dental units are focal point of dental clinics. Hand pieces (high-speed drills), air/water syringes, ultrasonic scalers, and prophylaxis angles are connected to dental units by a network of small-bore plastic tubing carrying water and air to activate or cool instruments. It has long been known that the water collected at the outflow of dental unit waterlines (DUWL) is densely populated, bacterial counts ranging from a few thousand to as high as 106 colony forming units (cfu)/ml, which can reflect the colonization of water lines by biofilms (Oliveira et al., 2008).

THEORETICAL AND CONCEPTUAL FRAMEWORK

This framework aimed to explain how microwaves can cause dielectric breakdown in cell membranes, leading to increased permeability of cell death. It integrates concepts from electromagnetism, thermodynamics, and cell biology.

The Dielectric Breakdown of Cell Membranes theory as postulated by Ulrich Zimmermann (1974) states that when an insulating compound, like that of a cell membrane, is exposed to strong electric field, it becomes conductive. Therefore, this disrupts the cell membrane, causing leakage of essential ions, and eventually causing cell death.

Zimmerman (1974) has demonstrated this with human and bovine red blood cells, along with *Escheria coli* B. and through the Coulter Counter and Laplace's equation for electric field strength. At 1.6v, the membrane has experienced breakdown at the order of 4×10^6 V/cm which is comparable to the breakdown voltages for bilayers in most oils. In his experiment, the red blood cells have lost hemoglobin completely due to dielectric breakdown. Moreover, the experiment has excluded other cell membrane breakdown mechanisms such as hemolysis.

The combination of electric and radiation energy produced by the microwave, converts into thermal energy, consequently generating heat. The increase in temperature disrupts the insulation of the cell membrane of the *aeruginosa*, which eventually creates pores within its cell membrane, which leads to the leakage of its essential ions and later to cell death. With this, there was an inhibition in the growth of *P. aeruginosa*, thus decreasing its bacterial infectivity.

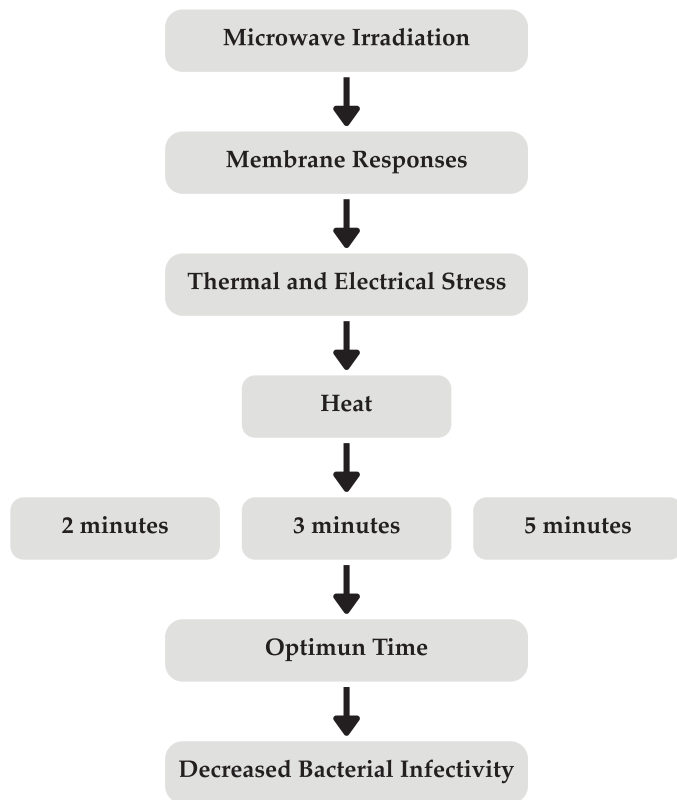


Figure 1: The Research Paradigm of the Study

The research paradigm shows that microwave irradiation, through thermal and electric properties, was utilized to deactivate the bacterial infectivity of *P. aeruginosa*, one of the bacteria abundant in dental instruments. The microwave irradiation represents the external application of microwaves to the cells having key parameters that include frequency, power, and duration. The interaction between the microwave properties and cell membrane are on a molecular level which encompasses dielectric polarization and ionic conduction. This dielectric interaction now caused thermal and electric stress to the cell membrane, leading to pore formation and thus membrane breakdown. This is the main theory that the researchers used in the inactivation of *P. aeruginosa*.

OBJECTIVES

This study evaluated the effectiveness of microwave irradiation as an alternative method for deactivating the infectivity of *Pseudomonas aeruginosa* aiming to enhance current means of

sterilization. The study assessed the following:

1. To determine the effectiveness of microwave in deactivating the infectivity of *Pseudomonas aeruginosa* in different time exposures:
 1. 2 minutes
 2. 3 minutes
 3. 5 minutes
2. To determine the difference in the effectiveness of microwave and autoclave in deactivating the bacterial infectivity of *Pseudomonas aeruginosa*.

MATERIALS AND METHODS

Research Method

This study used an experimental method of research to investigate the effectiveness of microwave irradiation as a tool for deactivating the infectivity of *Pseudomonas aeruginosa*. The researchers procured a microwave specifically designed for this study, ensuring that it met the necessary specifications for the experiments planned.

The study was conducted at Centro Escolar University-Manila. The research involved exposing *P. aeruginosa* cultures to varying durations and intensities of microwave radiation, followed by thorough assessments of bacterial viability. The data gathering was conducted utilizing a household microwave (1200-watts, 2.45-gHz) as its primary apparatus. Initially, the *P. aeruginosa* was inoculated for the purpose of culturing a colony. The experiment was carried out by depositing the cultured *P. aeruginosa* on several sets of periodontal handed instruments (probe and oral surgery instruments, each with their own variable. Specific parameters such as temperature and exposure time (e.g. 2 mins, 3 mins, and 5 mins). Swab inoculation method was used to measure the bacterial count after exposure to microwave radiation.

The data gathered from these experiments was analyzed to identify the relationship between microwave exposure and the deactivation of *P. aeruginosa*. The results provided important insights into new strategies for sterilizing dental instruments.

Procedures

1. Subculturing and Incubation of *Pseudomonas aeruginosa*

To begin the procedure, the *P. aeruginosa* specimen was procured from the University of the Philippines-Manila. The researchers then prepared the Nutrient Agar broth, consisting of nutrient agar powder and distilled water, then placed in an autoclave for 45 minutes. The melted Nutrient Agar broth was poured into sterile petri dishes and incubated. The researchers inoculated the *P. aeruginosa* to the Nutrient Agar plates using sterile cotton swabs dipped in sterile saline solution. After that, the inoculated agar plate was put under UV light for 15 minutes then incubated for 24 hours to ensure that there would be bacterial growth, preferably several well-isolated colonies.

2. Mcfarland Standard

Mcfarland Standard was a technique used for consistency and accuracy of microbiological procedures. This was done to ensure that the number of bacteria that would have transferred to the forceps and scalers would not grow beyond a given range, standardizing the microbial test. The researchers used a sterile loop; several well-isolated colonies from the fresh PCA plate were transferred to a sterile tube containing sterile saline solution. The turbidity of the bacterial suspension was adjusted to match a 0.5 McFarland standard. This is done by visually comparing the bacterial suspension to the 0.5 McFarland standard against a white background with black lines.

3. Inoculation of Bacteria to Instruments

From the prepared bacterial suspension, the bacteria would have then inoculated to the different sets of forceps and scalers. There would have been five different sets for each forceps and scalers; three of which was for the different time exposure, one set was for the controlled group and the fifth set was for the negative group. Each forcep and scaler will then be covered with aluminum foil. The instruments were covered with aluminum foil and were incubated for 24 hours to allow the bacteria to grow.

4. Semi-Quantitative Scoring for the Before value

After incubation, semi-quantitative scoring was used to approximate the colonies present on plates without needing to count every single colony. This method allows the classification of bacterial growth into meaningful categories. The categories are as follows:

Mild: Few isolated colonies, covering less than 25% of the agar surface.

Moderate: Confluent growth in some areas, covered 25-75% of the agar surface.

High: Heavy growth, a lawn of colonies covered more than 75% of the agar surface.

5. Sterilization of Instruments

5a. Microwave Irradiation of Instruments

After 24 hours, the contaminated set of instruments were transferred in a sterilization pouch and were then placed in a damp muslin cloth to simulate the standard procedure for autoclave sterilization. The dental instruments were placed in a rotating disc inside the microwave oven at 1200 watts for 3 sets of time exposure (2 mins, 3 mins, 5 mins). Immediately after each trial, the instruments were swabbed to the prepared Plate Count Agar (PCA) and incubated for another 24 hours to determine the microbial growth after microwave irradiation.

5b. Autoclave Sterilization for the Control Group

Another set of contaminated forceps and scalers were transferred to the sterilization pouch. There is only one instrument for every sterilization pouch to avoid cross-contamination between the instruments. Each of the instruments was then placed in

an autoclave set at 21C 15psi, for 30 minutes. Immediately after each trial, the instruments were swabbed to the prepared Plate Count Agar (PCA) and incubated for another 24 hours to determine the microbial growth after autoclave sterilization.

6. Result

Growth number of the bacteria was recorded by categorizing the bacterial growth based on semi-quantitative scoring. The growth of the set up would then be compared with the controlled group.

7. Disposal of Cultured *Pseudomonas aeruginosa*

Petri dishes containing inoculated bacteria were disinfected using a disinfectant, such as liquid Lysol or bleached. Inoculated bacteria was transferred to a designated biohazard bag, sealed securely, and vented to release excess air. The biohazard bag containing the inoculated bacteria was autoclaved for a duration of 45 minutes.

Proper disposal of all contaminated disposable materials must be carried out in accordance with biohazard wasted guidelines.

The effectiveness of microwave irradiation in deactivating *P. aeruginosa* was measured using standardized bacterial viability assays before and after exposure. Data from these trials would have been statistically analyzed to verify that the instrument (microwave device) and the procedures will consistently produce reliable outcomes, further enhancing the overall validity of the researched instrument.

This meticulous approach to researched procedure scrutiny underscores the researchers' commitment to produce reliable and informative results, contributing valuable insights into alternative sterilization methods in dentistry.

Statistical Treatment of Plan

In order to have a definite result based on the data the researchers obtained, different statistical treatments were used. The bacterial count after exposure to microwave radiation is the data of the study.

The researchers gathered the mean value of exposure time of the instruments and frequency of the microwave. The frequency of the microwave had a constant value of 1200 watts. The standard deviation was calculated once the mean values have been collected.

To analyze the data gathered, Chi-square test of Independence was conducted to determine the significant difference in the bacterial growth in both forceps and scaler across different exposure times.

To analyze the data gathered, Chi-square test of Independence was conducted to determine the significant difference in the

bacterial growth in both forceps and scaler across different exposure times.

RESULTS AND DISCUSSION

I. Microbial Colony Count in Instruments Before Exposure to Microwave Irradiation

Repetition/ Trial	Negative Control	Microwave			Positive Control
		2 mins	3 mins	5 mins	
1	Heavy	Heavy	Heavy	Heavy	Heavy
2	Heavy	Heavy	Heavy	Heavy	Heavy
3	Heavy	Heavy	Heavy	Heavy	Heavy

Table 1. Bacterial Growth in Forceps Before Exposure to Microwave Irradiation

Based on Table 1, we can interpret the data regarding bacterial growth on forceps prior to exposure to microwave irradiation under different exposure times and control conditions. All trials (1, 2, and 3) showed “Heavy” bacterial growth for the 2-minute, 3-minute, and 5-minute exposures. This consistent result suggests that the forceps used in these trials contained a significant bacterial load or were contaminated with bacteria.

Repetition/ Trial	Negative Control	Microwave			Positive Control
		2 mins	3 mins	5 mins	
1	Heavy	Heavy	Heavy	Heavy	Heavy
2	Heavy	Heavy	Heavy	Heavy	Heavy
3	Heavy	Heavy	Heavy	Heavy	Heavy

Table 2. Bacterial Growth in Scaler Before Exposure to Microwave Irradiation

Based on the data in Table 2 it presents the results of bacterial growth in a scaler before exposure to microwave irradiation across multiple repetitions or trials at different time intervals (2 minutes, 3 minutes, and 5 minutes), along with positive and negative controls. All trials (1, 2, and 3) demonstrated “Heavy” bacterial growth at all time points (2, 3, and 5 minutes). This suggests that the scaler had a significant bacterial load before any treatment or exposure to microwave irradiation

II. Microbial Colony Count in Forceps After Exposure to Microwave Irradiation

Repetition/ Trial	Negative Control	Microwave			Positive Control
		2 mins	3 mins	5 mins	
1	Heavy	Mild	Heavy	Moderate	No growth
2	Heavy	Moderate	Heavy	Moderate	No growth
3	Heavy	Moderate	Mild	Mild	No growth

Table 3. Bacterial Growth in Forceps After Exposure to Microwave Irradiation

The table provides data on bacterial growth in forceps after exposure to different durations of microwave irradiation (2 minutes, 3 minutes, and 5 minutes) and included positive and negative controlled groups. It could have noted that in positive control, there was no growth in all trials, indicating that the control condition did not allow for bacterial growth. On the other hand, heavy growth in all trials for the negative control, confirming that the conditions were suitable for bacterial proliferation.

In terms of growth patterns, the data suggests that exposure to microwave irradiation could impact bacterial growth on forceps, but the results vary with exposure time. At 2 minutes, there is moderate to mild growth, which indicates some survival of bacteria after limited exposure. Meanwhile, at 3 minutes, there is a notable increase to heavy growth in two trials, suggesting that this duration might be optimal for certain bacteria to remain viable or proliferate, despite exposure to microwave irradiation. Moreover, at 5 minutes, growth declines to moderate and mild leveled, which implies that longer exposure may lead to the destruction of bacteria, indicating a possible threshold where irradiation becomes effectively bactericidal.

The findings indicate that microwave irradiation can potentially be used as a sterilization method, albeit with varying effectiveness depending on exposure duration. A focus on timing can enhance the efficiency of microbial control procedures.

	No Growth	Mild	Moderate	Heavy
Negative Control	--	--	--	3 (100.0%)
Microwave 2 mins	--	1 (33.3%)	2 (66.7%)	--
Microwave 3 mins	--	1 (33.3%)	--	2 (66.7%)
Microwave 5 mins	--	1 (33.3%)	2 (66.7%)	--
Positive Control	3 (100.0%)	--	--	--

Table 4. Bacterial Growth in Forceps Across Exposure Time

The table presents data on bacterial growth on forceps after different exposure times, comparing the results with a negative

control group (no bacterial exposure) and a positive control group (which presumably has higher expected bacterial growth). The data categories include “No Growth,” “Mild,” “Moderate,” and “Heavy” for the samples taken after 2, 3, and 5 minutes of exposure.

For the negative control group, there was 100% heavy growth (3 out of 3 samples) which suggests the control group was effectively contaminated. This indicates that without any intervention (cleaning or disinfection), the forceps are able to harbor bacteria. In contrast, there was 100% no growth (3 out of the 3 samples) in the positive control group. This suggests that all samples from this group were completely bacterial-free, indicating that the positive control served as a reliable benchmark for effective sterilization.

Meanwhile, the results imply that after 2 minutes of exposure, the majority of samples exhibit moderate growth of bacteria, suggesting that this duration of exposure is insufficient for effective sterilization. In addition, the results show a concerning trend, with most samples showing heavy growth after 3 minutes, further confirming that 3 minutes is still not adequate for sterilization. The data suggests that the exposure times (2, 3, and 5 minutes) are not sufficient for complete elimination of bacteria in the forceps, as evidenced by the persistent moderate and heavy growth categories.

III. Microbial Colony Count in Forceps After Exposure to Microwave Irradiation

The table revealed the results of an experiment examining bacterial growth in a scaler before exposure to microwave irradiation.

In terms of bacterial growth conditions; at 2 minutes, two trials show “Moderate” growth, while one trial shows “Mild” growth. This indicates that bacteria can still survive and proliferate even after two minutes of exposure. At 3 minutes, one trial exhibits “Moderate” growth while the other shows “Mild” growth. This suggests a slight increase in the effectiveness of microwave exposure in reducing bacterial viability compared to 2 minutes. Moreover, after 5 minutes, all trials show “No growth,” indicating that at this exposure duration, the microwave irradiation is effective in eliminating bacterial presence in the scaler.

Repetition/ Trial	Negative Control	Microwave			Positive Control
		2 mins	3 mins	5 mins	
1	Heavy	Moderate	Mild	No growth	No growth
2	Heavy	Moderate	Mild	No growth	No growth
3	Heavy	Mild	Moderate	Mild	No growth

Table 6. Bacterial Growth in Scaler After Exposure to Microwave Irradiation

Meanwhile, negative control is designated as “Heavy” growth across all trials, confirming that the experiment successfully supports bacterial growth when not treated. Positive control shows “No growth.” This confirms the absence of contamination or unintended growth outside of test conditions, affirming the reliability of the experimental results.

The data suggests that microwave irradiation can effectively eliminate bacterial growth in a scaler after a determined exposure time. A 5-minute exposure appears to be sufficient for total eradication of visible bacterial growth.

	No Growth	Mild	Moderate	Heavy
Negative Control	--	--	--	3 (100.0%)
2 mins	--	1 (33.3%)	2 (66.7%)	--
3 mins	--	2 (66.7%)	1 (33.3%)	--
5 mins	2 (66.7%)	1 (33.3%)		
Positive Control	3 (100.0%)	--	--	--

Table 7. Bacterial Growth in Scaler Across Exposure Time

Based on the provided table (Table 8), we can interpret the results of a bacterial growth study across different exposure times in a scaler.

For the results overview; Negative Control showed no growth is observed in this control condition. All (100%) samples show heavy growth at baseline. 2 Minutes Exposure revealed that 1 sample shows mild growth (33.3%), 2 samples show moderate growth (66.7%) and no samples show no growth or heavy growth. Furthermore, 3 Minutes Exposure indicated that 2 samples show mild growth (66.7%) and 1 sample shows moderate growth (33.3%). After 5-Minute Exposure, 2 samples show no growth (66.7%), 1 sample shows mild growth (33.3%). Lastly, for positive control, all samples show heavy growth (100%).

The data imply that bacterial growth decreases with increased exposure time in the scaler, particularly noticeable at the 5-minute mark where 66.7% of samples showed no growth. The diminishment of both moderate and heavy growth leveled indicates that the scaler had a significant bactericidal

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Remarks
Pearson Chi-Square	28.833	12	.004	.002	Significant
Likelihood Ratio	29.416	12	.003	.003	
Fisher's Exact Test	18.256			.003	

Table 8. Chi-Square Test of Independence of Bacterial Growth in Scaler Between Different Exposure Time

or bacteriostatic effect with sufficient exposure time. Bacterial growth appeared to be time-dependent, with shorter exposure times (2 and 3 minutes) resulting in higher levels of mild and moderate growth. This indicates that longer exposure times are necessary to effectively reduce bacterial levels.

Meanwhile, the negative control effectively demonstrates that without exposure to the scaler, heavy bacterial growth was likely, establishing a baseline for the effectiveness of the scaler.

Both the Pearson Chi-Square tested and the Likelihood Ratio tested yield p-values (Asymptotic Significance) of .004 and .003, respectively. These values were below the conventional alpha levels of 0.05, indicating that there was a statistically significant association between exposure time and bacterial growth in the scaler. The Fisher's Exact Test also showed statistical significance with a p-value of .003. This was particularly relevant if sample sizes were small or if the assumptions of the Chi-Square test are not satisfied. Significant results indicate that different exposure time affects the level of bacterial growth in scalers, suggesting that exposure time plays a crucial role in controlling bacterial growth.

IV. Comparison Between the Effectiveness of Deactivating

	No Growth	Mild	Moderate	Heavy
Negative Control	--	--	--	3 (100.0%)
2 mins	--	1 (33.3%)	2 (66.7%)	--
3 mins	--	2 (66.7%)	1 (33.3%)	--
5 mins	2 (66.7%)	1 (33.3%)		
Positive Control	3 (100.0%)	--	--	--

Table 9. Bacterial Growth in Scaler Across Exposure Time

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Remarks
Pearson Chi-Square	28.833 ^a	12	.004	.002	Significant
Likelihood Ratio	29.416	12	.003	.003	
Fisher's Exact Test	18.256			.003	

Table 10. Chi-Square Test of Independence of Bacterial Growth in Scaler Between Different Exposure Time

Based on the provided table, we could interpret the results of a bacterial growth studied across different exposure times in a scaler. Negative Controlled showed no growth observed in this controlled condition. All (100%) samples showed heavy growth at baseline. 2 Minutes Exposure revealed that 1 sample showed mild growth (33.3%), 2 samples showed moderate growth (66.7%) and no samples show no growth or heavy growth. Furthermore, 3 Minutes Exposure indicated that 2 samples show mild growth (66.7%) and 1 sample shows moderate growth (33.3%). After 5-Minute Exposure, 2 samples show no growth (66.7%), 1 sample shows mild growth (33.3%). Lastly, for positive control, all samples show heavy growth (100%).

The data imply that bacterial growth decreases with increased exposure time in the scaler, particularly noticeable at the 5-minute mark where 66.7% of samples showed no growth. The diminishment of both moderate and heavy growth leveled indicates that the scaler may have a significant bactericidal or bacteriostatic effect with sufficient exposure time. Bacterial growth appeared to be time-dependent, with shorter exposure times (2 and 3 minutes) resulting in higher levels of mild and moderate growth. This indicates that longer exposure times were necessary to effectively reduce bacterial level.

Meanwhile, the negative control effectively demonstrates that without exposure to the scaler, heavy bacterial growth was likely, establishing a baseline for the effectiveness of the scaler.

Both the Pearson Chi-Square tested and the Likelihood Ratio tested yield p-values (Asymptotic Significance) of .004 and .003, respectively. These values were below the conventional alpha level of 0.05, indicating that there was a statistically significant association between exposure time and bacterial growth in the scaler. The Fisher's Exact Test also showed statistical significance with a p-value of .003. This was particularly relevant if sample sizes were small or if the assumptions of the Chi-Square test are

not satisfied. Significant results indicate that different exposure times affect the level of bacterial growth in scalers, suggesting that exposure time may play a crucial role in controlling bacterial growth.

Dental practices may need to carefully consider the duration of exposure times for decontaminating instruments. Implementing the optimal exposure time identified could lead to better control of bacterial growth, thereby ensuring patient safety and reducing the risk of cross-contamination. The results of the Chi-Square test indicate a significant relationship between exposure time and bacterial growth in scalers, suggest the need for attention to sterilization protocols in dental practice.

CONCLUSION

Based on the findings of the study, microwave irradiation can effectively reduce bacterial growth of *Pseudomonas aeruginosa* both on the forceps and scalers after a determined exposure time. The data is supported by the statistics showing a significant relationship between exposure time and bacterial growth in forceps and scalers suggesting that exposure time plays a crucial role in controlling bacterial growth. Limited to the data gathered, the study suggests that the most effective time exposure in reducing *Pseudomonas aeruginosa* infectivity using the microwave irradiation is 5 minutes. In addition, the data shows that the p-value for both the forceps and scalers fall short in reaching the traditional alpha levels, suggesting

that there is no significant difference in the bacterial growth of microwave and autoclave.

The study rejects the first null hypothesis as microwave irradiation is effective in deactivating the bacterial infectivity of *Pseudomonas aeruginosa*. This study, however, accepts the second null hypothesis as the effectiveness of microwave in deactivating the infectivity of the *P. aeruginosa* is comparable to the effectiveness of autoclave. Overall, the study supports that microwave irradiation can potentially be used as an alternative sterilization method.

RECOMMENDATIONS

Based on the findings, the researchers would like to recommend the following:

1. To conduct a research aimed at improving the mechanism utilizing microwave irradiation and to establish new methods to completely eliminate microorganisms
2. To conduct further studies on microwave irradiation with extended exposure times of 10, 20, and 30 minutes in order to achieve complete bacterial elimination
3. To conduct additional studies to determine the effectivity of microwave irradiation against bacteria aside from *Pseudomonas aeruginosa* harbored in different dental instruments (e.g. *Staphylococcus aureus*, *Streptococcus*, and *Enterococcus faecalis*) and other microorganisms that have high resistance against sterilization (e.g. MRSA)

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Comparative Study on the Efficiency of a Manual Periodontal Probe and a Pressure-sensitive Probe in Measuring Probing Pocket Depths

Ma. Celina U. Garcia, DDM¹

Bianca P. Tumang, DDM¹

Maria Bernadette G. Ramos, DDM¹

¹College of Dentistry, University of the Philippines Manila, Philippines

ABSTRACT

Background: Previous investigations that have compared the efficiency of manual and pressure-sensitive periodontal probes are limited and have yielded conflicting results. Determination of the more efficient probe type may guide dentists, dental educators, and students as to which periodontal probe should be used for examining patients.

Objective: This present study aimed to compare the efficiency of a manual probe with a pressure-sensitive probe, as used by junior and senior dental student clinicians.

Methods: Eight senior and eight junior dental student clinicians participated in the study. A periodontal model was positioned on a digital scale. Participants were instructed to perform periodontal probing four times, twice using a UNC-15 manual probe and twice employing a Gram Probe #2 pressure-sensitive probe. The order of probe usage was randomly assigned. The time spent probing, forces employed, and probing pocket depths (PPD) on six sites of six teeth were recorded. The efficiency of the two probes was determined based on the following: (1) mean probing time to finish measurement of PPD, (2) correlation between probing time and accuracy of probing forces, and (3) correlation between probing time and accuracy of PPD measurements. T-test was employed to analyze the differences in mean probing times. Pearson correlation coefficient (PCC) was used to determine the association between probing time and probing force accuracy, as well as probing time and PPD measurement accuracy. Statistical significance was set at ≤ 0.05 .

Results: Generally, probing times significantly decreased during second probing sessions, regardless of the students' clinical level and the type of probe used. However, when probing time was compared between the manual and pressure-sensitive probe, the more efficient probe differed depending on the probing session and clinician level. Correlation between probing time and probing force accuracy revealed a negative correlation for the manual, and positive correlation for the pressure-sensitive probe. On the other hand, statistical analysis yielded a positive correlation between probing time and PPD accuracy for both probes.

Conclusion: The conflicting results of this study preclude the selection of a more efficient periodontal probe between the manual and pressure-sensitive probes that were used by dental student clinicians for measuring PPD. Additional studies using larger sample sizes of participants with varied periodontal training level are recommended.

Keywords: accuracy, efficiency, periodontal pocket, periodontal probes

INTRODUCTION

The diagnosis of periodontal diseases is traditionally based on clinical assessment and radiographic analysis (Heitz-Mayfield, 2024). In order to supplement these conventional diagnostic measures, periodontal research over the past few decades has explored quantifying host defense components in gingival crevicular fluid and saliva as potential diagnostic biomarkers for periodontitis (Buduneli et al., 2024; Ebersole et al., 2024). Moreover, investigators have also looked into microbial sampling and genomics, not only for diagnosis, but also for monitoring of patients' periodontal conditions following active periodontal treatment (Ramseier, 2024; Manoil et al. 2024; Nibali et al., 2024). However, despite the potential of the aforementioned laboratory diagnostics, clinical evaluation through periodontal probing remains the standard of care for periodontal clinical diagnosis (Herrera et al., 2025).

Manual periodontal probes were the first to be developed and are the most commonly used among both general dental practitioners and periodontists. Also referred to as conventional or first-generation probes, they are used to assess probing pocket depths, clinical attachment levels (CAL), and bleeding on probing (Stødle et al., 2025; Ramachandra et al., 2022; Hefti). Examples of manual probes are the Williams, Community Periodontal Index of Treatment Needs, University of Michigan O, and the University of North Carolina-15 (UNC-15). Among the manual probes, the UNC-15 is preferred for use in periodontal research, because the probe has demarcations at every millimeter from 1-15. Also, the UNC-15 is longer than all other manual periodontal probes, allowing assessment of deeper pockets (Ramachandra et al., 2011; Pihlstrom, 1992).

According to Chapple et al. (2018) in the Consensus Report on Periodontal Health and Gingival Diseases, periodontal probes should have standardized features, which include a cylindrical working end with 1.75-degree taper and 0.5 mm tip diameter, individual millimeter markings up to 15mm, and a constant force limiter of 25g (0.25N). The UNC-15 possesses all of the aforementioned characteristics, except for being pressure-sensitive, which is a characteristic that is missing in all first-generation probes.

Pressure-sensitive probes have been developed to allow for standardization of the applied pressure during periodontal probing, thereby avoiding errors attributable to the use of incorrect probing forces. Also known as constant force or second-generation probes, these instruments guide users in applying the recommended 25g of force when assessing bleeding, and measuring PPD and CAL (Elashiry et al., 2019; Ramachandra et al., 2011). When probing forces exceed 25g, bleeding may occur because of trauma, and not because of inflammatory changes in the gingiva (Lang et al., 1991). Moreover, overestimation of PPD and CAL may occur because of increased probe displacement when applying too much force (Larsen et al., 2009).

Several studies have compared the accuracy and reproducibility of applied forces when using manual and pressure-sensitive periodontal probes. To date, the results have been inconclusive. Some of these studies include that by Al Shayeb et al. (2014), who reported that the Vivacare TPS pressure-sensitive probe yielded the most accurate and reproducible probing forces, compared to another second-generation probe, the Chapple probe. Moreover, when compared to the two pressure-sensitive probes, the manual Williams probe was the least accurate and reproducible. In contrast, Mayfield et al. (1996) concluded that the Hu-Friedy LL-20 manual probe was the most reproducible in measuring PPD, compared to Vivacare TPS probe and two electronic probes. Meanwhile, our research group compared the UNC-15 with a pressure-sensitive probe, the Gram probe #2. More accurate PPD measurements were recorded using the UNC-15, but forces were more reproducible and closer to the recommended 25g when using the Gram Probe #2 (Garcia, et al. 2022).

On the other hand, only a limited number of studies have determined the efficiency of periodontal probes. In previous investigations, probe efficiency has been measured by looking into the time spent on periodontal probing. To the authors' knowledge, only one study has compared the efficiency of first- and second-generation probes. Others have compared either a first- or second-generation probe with an electronic probe that also controls pressure while automatically recording periodontal parameters into a computer. On average, it took 3 minutes and 59 seconds to perform full-mouth probing and recording of PPD on six sites when using a Marquis type manual probe. In contrast, using a pressure-sensitive probe (True Pressure Sensitive Pocket Searcher, Ivoclar Vivadent, Inc.), the average probing time was 4 minutes and 18 seconds. Statistically, there was no significant difference between the two periodontal probes (Perry et al., 1994). Similarly, in a study that compared a second-generation probe (DB76R, Aesculap) with an electronic probe (PA-ON Parometer, Orangedental), the time needed for assessment was not statistically different (Laugisch et al., 2021). On the other hand, it took a significantly longer time to perform clinical assessment using a Williams manual probe as compared to an electronic probe (Pa-ON Perimeter,) in a study by Mărtu et al. (2014).

In addition to probing force, the examiner's level of training may influence the accuracy and efficiency of periodontal probing. One study which compared dental students with and without prior clinical experience revealed that the latter group with some training demonstrated higher agreement with faculty members, in terms of measured PPD values (Drucker et al., 2012). Moreover, in the study by Laugisch et al. (2021), dentists and dental students in their 7th and 10th semester of schooling were timed while performing periodontal probing. The researchers reported a decreasing trend for the required time to complete probing as examiner experience increased.

In contrast, Baker et al. (1997) reported that when compared to a highly trained clinician, clinicians with minimal training obtained reproducible and comparable PPD measurements.

In light of the limited number of studies that have compared the efficiency of manual and pressure-sensitive periodontal probes, along with the conflicting results from previous investigations, this present study aimed to compare the efficiency of a manual probe with a pressure-sensitive probe, as used by junior and senior dental student clinicians. Specifically, this study aimed to (1) compare the time spent for probing using the two types of probes, (2) correlate the accuracy of probing forces with time spent for probing, and (3) correlate the accuracy of recorded probing depths with time spent for probing.

METHODOLOGY

Study Design and Study Population

This study received technical approval from a College Technical Review Committee and ethical clearance from the University of the Philippines Manila Research Ethics Board. An experimental study with randomized block design was used and the methodology was adapted from the research of Al Shayeb et al. (2014).

Study participants were eight junior and eight senior dental student clinicians from the College of Dentistry, University of the Philippines Manila, all of whom gave written informed consent to participate. Junior clinicians were at the 5th year level of the Doctor of Dental Medicine (DDM) program and had less than one year of clinical training in Periodontics. On the other hand,

senior clinicians were students at the 6th year level of the DDM program, who had been managing periodontal patients for ≥ 1 year. The student participants were randomly selected from the complete roster of junior and senior clinicians. The sample size of 16 (eight each of junior and senior dental students) was determined based on the mean probing forces (31.9 ± 8.26 g) used by Prosthodontic Postgraduate students with a Vivacare pressure-sensitive probe in the study by Al Shayeb et al. (2014). Power was set at 0.9 with significance ≤ 0.05 .

Data Collection

The manual periodontal probe used in the study was a UNC-15 periodontal probe (PCPUNC156, Hu-Friedy, Chicago, USA). The UNC-15 is not pressure-calibrated and has demarcations at each millimeter from 1 to 15mm (Figure 1).

On the other hand, the pressure-sensitive probe employed was the Gram Probe #2 (Code No. 09204, YDM Corporation, Tokyo, Japan). The probe has demarcations at 1, 2, 3, 5, 7, 8, 9, and 10 mm and has a movable shank that springs back once 20-25g of force has been exerted during probing (Figure 2).

Participants performed probing on a periodontal model (PER2001-UL-SP-M-32, Nissin Dental Products Inc., Kyoto, Japan), which was placed on a digital scale (ProCook®, United Kingdom). The scale was adjusted to zero prior to commencement of each probing session. A wooden frame was placed around the digital scale and periodontal model (Figure 3). No part of the scale was in contact with the wooden frame, which provided space for the participants to place their finger



Figure 1. University of North Carolina-15 periodontal probe



Figure 2. Gram Probe #2

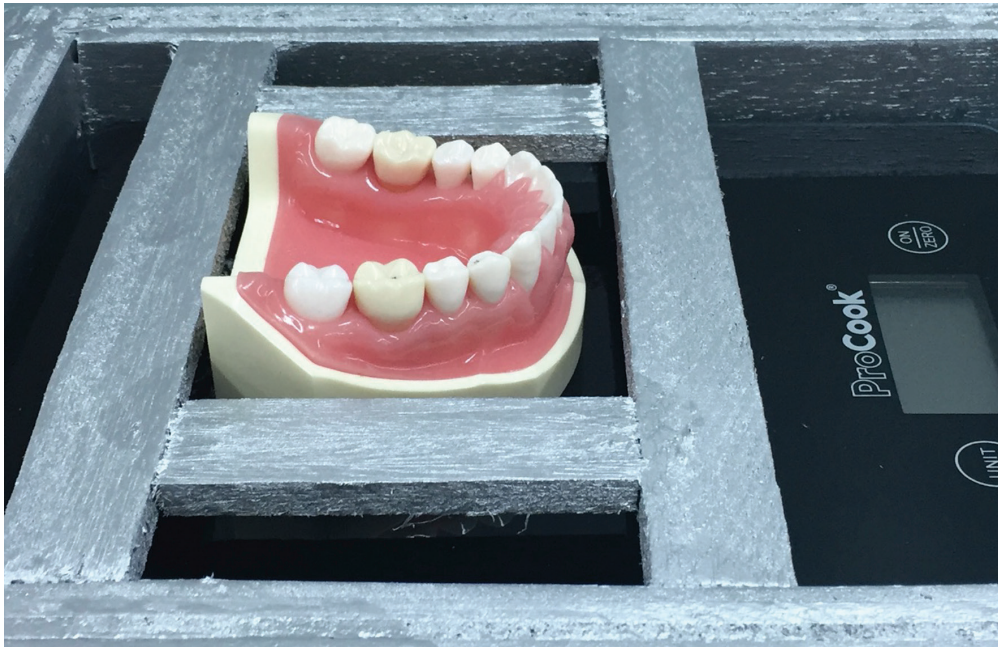


Figure 3. Periodontal model-digital scale set-up with wooden frame

rests, without affecting the force readings. The digital scale readings faced the researchers, and the participants could not directly see the readings.

Each participant performed periodontal probing to measure PPD on six sites (mesiobuccal, mid-buccal, distobuccal, distolingual, mid-lingual, and mesiolingual) of six selected anterior and posterior teeth (16, 21, 24, 36, 41, and 44). For each periodontal probe, probing was done twice at 15-minute intervals. Therefore, participants performed periodontal probing a total of four times, with the order of probe usage assigned randomly (Figure 4). During each probing session, the participants read the PPD measurements out loud. The researchers took note of the probing force that simultaneously appeared on the digital scale when each PPD was called out. The PPD measurements, the corresponding forces employed, and the time spent to complete probing of six teeth were recorded initially and after a 15 minute interval.

Statistical Analysis

T-test was employed to compare the amount of time spent (in seconds) for periodontal probing by junior and senior dental student clinicians. Pearson correlation coefficient was used to determine the association between probing time and probing force accuracy, which was measured as the difference between probing forces employed and the standard 25g. Likewise, PCC was also used to determine the association between probing time and the accuracy of probing depths. The latter was based on the difference of recorded PPD from the actual PPD on the different tooth sites of the periodontal model. Data were analyzed using SPSS software, and p -values ≤ 0.05 were considered statistically significant.

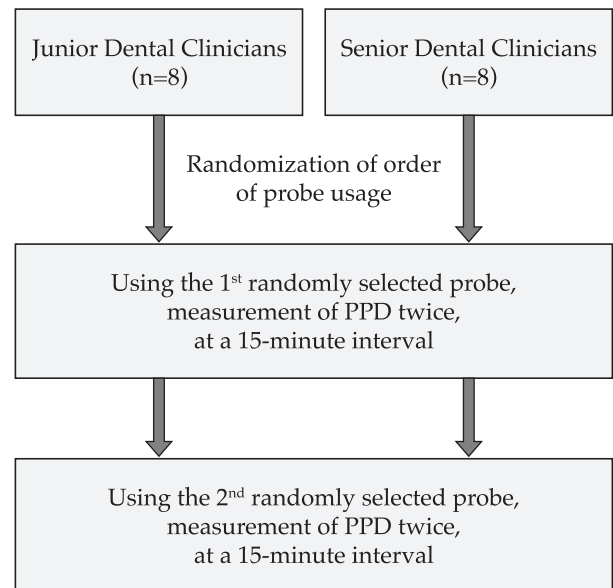


Figure 4. Procedural flowchart of the study

RESULTS

Comparative Probing Times of Junior and Senior Dental Student Clinicians in Measuring Probing Pocket Depths

The mean time required for junior and senior clinicians to finish periodontal probing using the UNC-15 periodontal probe and Gram Probe #2 can be seen in Table 1.

Generally, probing times significantly decreased during the second probing session, regardless of the students' clinical level

Table 1. Mean probing time (seconds) to measure PPD using a UNC-15 periodontal probe and Gram Probe #2.

Clinician Level	Mean Probing Time (seconds)							
	UNC-15				Gram Probe #2			
	Average of 2 Sessions	Probing Session 1 (Initial)	Probing Session 2 (After 15 minutes)	<i>p</i> -value	Average of 2 Sessions	Probing Session 1 (Initial)	Probing Session 2 (After 15 minutes)	<i>p</i> -value
Juniors	385.12	447.25	323*	0.004	342	390.25	293.75*	0.004
Seniors	305.38	347.75†	263	0.002	266.5	314.75†	218.25	0.004

* *p*-value= 0.1832† *p*-value= 0.0863

and the type of probe used. When comparing probing times between junior and senior clinicians, no significant differences were observed within any time point ($p < 0.05$). However, when probing time was compared between the UNC-15 and Gram Probe, there was no significant difference between the time it took juniors to finish the second probing sessions while using the two periodontal probes ($p = 0.1832$). Moreover, among the senior clinicians, comparison between probing session 1 using the UNC-15 and probing session 1 using the Gram Probe yielded a *p*-value of 0.0863. On the other hand, junior clinicians took significantly less time using the Gram Probe compared to the UNC-15 during the initial probing sessions, while senior clinicians were significantly faster when they used the Gram Probe during the second probing session as opposed to their second session of probing using the UNC-15. When the average of the first and second probing sessions for both probes was computed, significantly less time was spent for probing when using the Gram probe, both for junior ($p = 0.0028$) and senior students ($p = 0.0103$).

Correlation Between Probing Time and the Accuracy of Probing Forces Employed

The accuracy of probing forces was computed by obtaining the difference between the mean probing forces employed and the standard force of 25g. Correlation of the computed differences with probing time revealed a negative correlation when using the UNC-15, both for junior and senior clinicians. As probing forces became more accurate, clinicians took longer to finish periodontal probing. The correlation was moderate for juniors but only weak for senior clinicians (Figure 5a and 5b).

Correlation Between Probing Time and the Accuracy of Probing Pocket Depths

The accuracy of PPD values obtained was determined by computing the difference between the recorded PPD and the actual PPD of the different tooth sites of the periodontal model. Correlation of the computed differences with probing time revealed a positive correlation when using both the UNC-15 and Gram Probe #2, as employed by both junior and senior dental

clinicians. As PPD became less accurate, i.e., greater difference from the actual PPD was noted, clinicians needed more time to finish periodontal probing. The correlation was moderate, except when senior clinicians used a Gram Probe, wherein a weak positive correlation was observed (Figure 6).

DISCUSSION

This study aimed to compare the efficiency of a manual periodontal probe with a pressure-sensitive probe, as used by junior and senior dental student clinicians. When the probing times employed by the two groups of clinicians were compared, although the juniors consistently took longer than the senior clinicians, the differences were not statistically significant. In contrast, Laugisch et al. (2021) recorded the probing times of dentists, as well as that of dental students in their 7th and 10th semester of dental studies. The researchers observed that with increasing examiner experience, the time required to finish probing decreased. On the other hand, the observed equivalence among examiners in this present study is in line with the research of Baker et al. (1997), wherein clinicians with minimal experience in periodontal probing were comparable to a highly trained clinician. However, in the study of Baker et al., the accuracy and reproducibility of measured PPD were compared, and not the probing time.

Comparison of probing times when using the UNC-15 and Gram Probe #2 yielded inconsistent results. No statistically significant difference was found during the first probing sessions of the senior clinicians and during the juniors' second probing sessions using the two periodontal probes. The comparable probing times observed between the manual and pressure-sensitive probes are in line with the study of Perry et al. (1994), who reported no significant difference between a Marquis type manual probe and the True Pressure Sensitive Pocket Searcher, which is a pressure-sensitive probe. On the other hand, during probing session 1 of each periodontal probe, junior dental clinicians finished periodontal probing faster when they used the Gram Probe, while the senior clinicians also probed faster using the Gram probe, but this was observed during their second probing

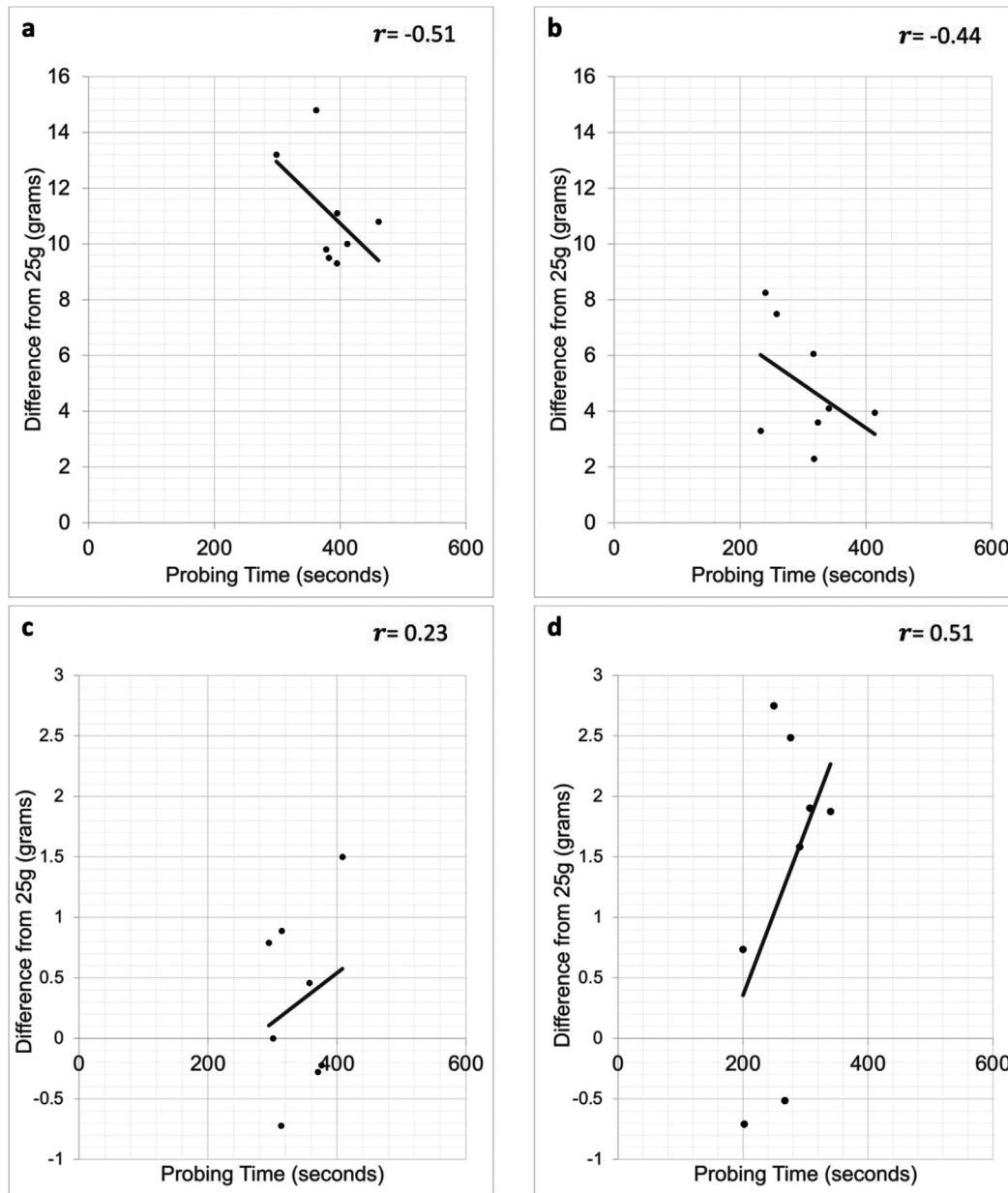


Figure 5. Correlation between probing time and the accuracy of probing forces employed by (a) junior clinicians using a UNC-15, (b) senior clinicians using a UNC-15, (c) junior clinicians using a Gram Probe #2, and (d) senior clinicians using a Gram Probe #2

sessions. Moreover, when the average of the first and second probing sessions for both probes was computed, significantly less time was spent for probing when using the Gram probe, for both clinician levels. These results are similar to the findings of Mărtu et al. (2014), who compared a Williams probe to an electronic probe, and concluded that the latter was more efficient. The results of this present study and that of previous research are equivocal. However, methodological differences such as the types of examiners/participants, periodontal probes, and performance of probing on periodontal models versus actual patients, preclude concluding which type of probe is more

efficient. Additional studies on a greater number of participants with varied training levels are therefore recommended.

In this study, we also determined the correlation between probing time and the accuracy of probing forces. Our research group has previously reported on the accuracy of a UNC-15 and Gram Probe #2 by comparing the mean probing forces obtained using the periodontal probes, to the standard force of 25g (Garcia et al., 2022). On the other hand, in this present study, the accuracy of probing forces was based on the difference between the mean probing forces employed and the 25g standard

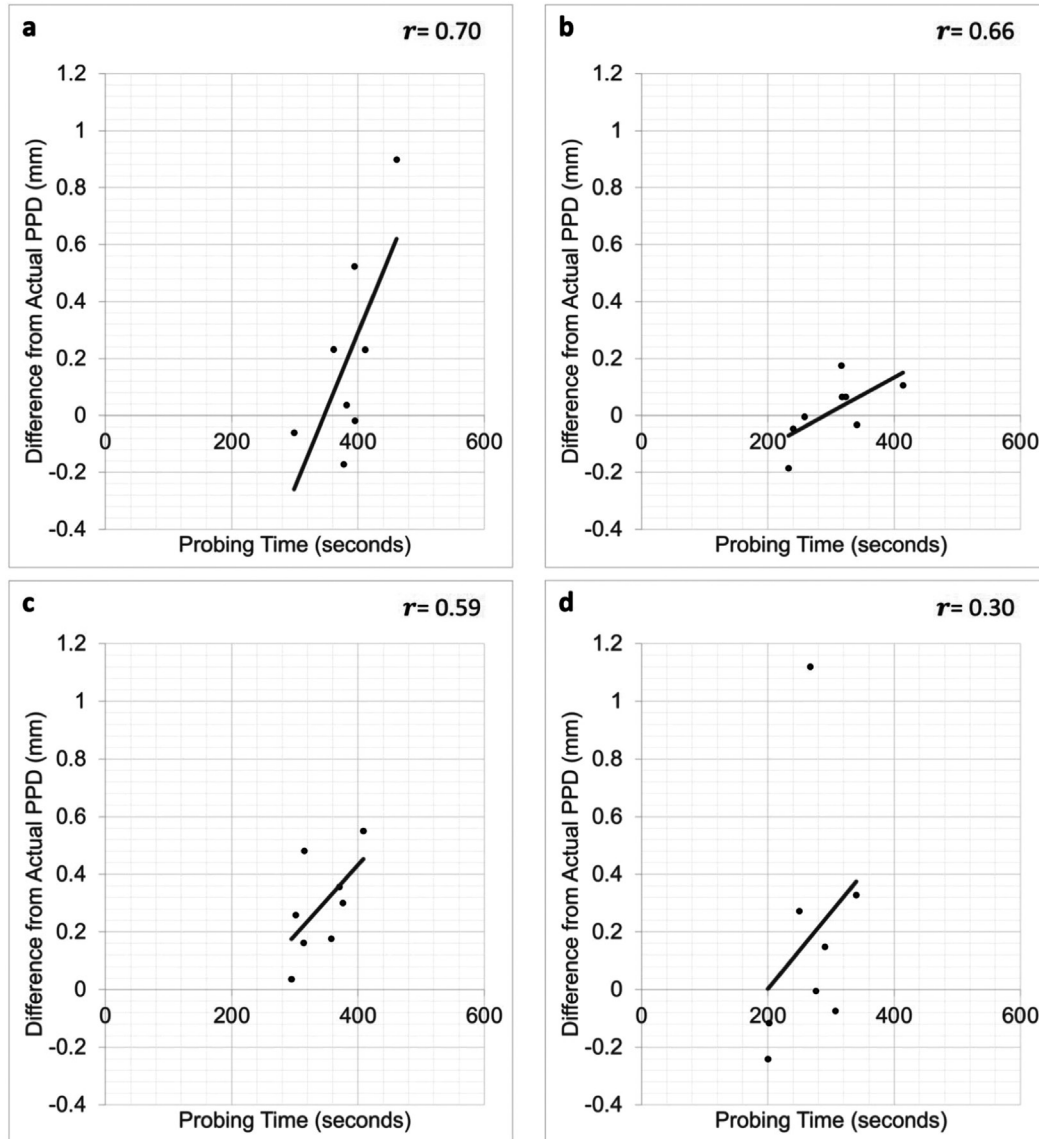


Figure 6. Correlation between probing time and the accuracy of PPD measurement by
(a) junior clinicians using a UNC-15, (b) senior clinicians using a UNC-15,
(c) junior clinicians using a Gram Probe #2, and (d) senior clinicians using a Gram Probe #2

force. When using the UNC-15, a weak to moderate negative correlation was observed among all clinicians, which means that as probing forces became more accurate, the clinicians spent more time probing. On the other hand, the reverse was observed when using the Gram Probe. To the authors' knowledge, there are no previous studies which have investigated the correlation between probing time and probing force accuracy. Therefore, it is advisable that future studies also explore this association to better guide educators and dentists on which periodontal probe to use.

Lastly, we aimed to correlate probing time to the accuracy of recorded probing pocket depths. In our research group's previous study, we also determined the accuracy of a UNC-

15 and Gram Probe #2 in measuring PPD, by comparing PPD values obtained through probing to the actual PPD measurements of a periodontal model (Garcia et al., 2022). Meanwhile, in this present study, we based PPD accuracy on the differences between the measured PPD and the actual PPD of the different tooth sites of the periodontal model. Among all junior and senior dental clinicians, and using both periodontal probes, statistical analysis yielded a weak to moderate positive correlation. This meant that ironically, when the clinicians took longer to finish probing, which some may interpret as exerting more caution, the PPD values obtained became less accurate, by virtue of the higher difference of the obtained PPD to the actual PPD. To the authors' knowledge, neither have there been previous studies which investigated the correlation between

probing time and the accuracy of measured PPD. Therefore, to add to our aforementioned recommendations, we suggest that future studies also explore this association when comparing manual and pressure-sensitive periodontal probes.

Certain limitations must be considered when interpreting the present study's results. Although the minimum sample size was met, a sample size of 16 is small. The results may only be representative of student clinicians at the College of Dentistry, University of the Philippines Manila, and cannot be extrapolated to other dental students in the Philippines and globally. Also, the first and second probing sessions for each periodontal probe were conducted at a 15-minute interval, adapted after the study of Al Shayeb et al. (2014). Other studies have employed a longer interval of one week (Perry et al, 1994 ; Mayfield et al., 1996). With the shorter probing session interval used in this present study, the possibility of recall bias of PPD values exists. Therefore, a longer interval between probing sessions may be needed in future investigations, in order to reduce the probability that participants will remember PPD measurements at the time of their second probing session.

CONCLUSIONS

The conflicting study results preclude the selection of a more efficient periodontal probe between the manual and pressure-sensitive probes that were used by dental student clinicians for measuring probing pocket depths. On the other hand, comparison of probing efficiency based on mean probing times revealed no significant difference between junior and senior dental clinicians.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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A Single-Blinded Study on the Effects of Hydroethanolic Extract from Ginger (*Zingiber officinale* Roscoe) Rhizomes on Salivary Flow Rate, pH, and Buffering Capacity

E.J. Alingarog¹
F.L. Estonactoc¹

J. Belgica¹
B.D. Jurada¹

C.V. Caluya¹
L.A.J. Lequiron¹

K.F. Declasin¹
J.R. Reyes¹

B.A. Estabaya¹
H.R. Hallare¹

¹School of Dentistry, Centro Escolar University Manila, Philippines

ABSTRACT

Saliva plays a vital role in oral and systemic health, with adequate salivary flow rate, pH, and buffering capacity protecting against oral diseases, whereas compromised salivary function increases susceptibility. Ginger (*Zingiber officinale* Roscoe) powder has demonstrated sialogogic effects; however, evidence is limited regarding hydroethanolic extract form, and its effects on pH and buffering capacity. This study aimed to evaluate the effects of hydroethanolic ginger extract on salivary flow rate, pH, and buffering capacity. Thirty-four participants were randomly assigned to two groups (n = 17): a control group using distilled water and an experimental group using the extract. Saliva samples were collected for five minutes before and after a one-minute oral swishing procedure. Salivary flow rate was measured in mL/min, while pH and buffering capacity were assessed using 2-in-1 test strips. Dependent and independent t-tests were used for data analysis. Results showed an increase in salivary flow in both groups, with a greater increase observed in the experimental group, likely due to mechanical and gustatory stimulation. Salivary pH showed a slight increase, while buffering capacity exhibited minimal change, likely due to short exposure duration. Findings suggest that hydroethanolic ginger extract enhances salivary flow and may aid oral lubrication and debris clearance.

INTRODUCTION

Saliva is a fluid produced by both major and minor salivary glands. The major glands contribute most of the saliva's volume and primary chemical components, while numerous minor glands, distributed throughout the oral mucosa, provide additional secretions. As a predominantly watery fluid, saliva contains a complex mixture of biological and chemical substances that play essential roles in maintaining the health of oral structures, including the teeth and mucosal tissues.

With the rising interest in natural functional foods and natural therapeutics, researchers increasingly examine plant-based compounds for their potential to enhance salivary secretion and support oral health. Ginger is widely valued for its bioactive compounds, which exhibit antioxidant and anti-inflammatory properties. It is commonly consumed in various forms, including fresh slices, teas, powders, and even candies, making

it easily accessible for use in studies and daily consumption (Modi & Modi, 2024).

A study by Wongkalasin et al. in 2023 investigated the effects and safety of a standardized, commercially available ginger powder capsule on unstimulated salivary flow rate (USFR) in healthy adults. The findings indicated that ginger can modestly stimulate saliva production, supporting its potential to improve oral health.

This study focused on determining the immediate effects of a hydroethanolic extract of ginger rhizomes on salivary flow rate, pH, and buffering capacity, with distilled water serving as the control. A quantitative, true experimental design with a single-blind approach was employed, involving randomly selected fifth year dentistry students under controlled conditions. Pre- and post-intervention measurements were obtained to allow

comparison within and between groups.

The scope of this research was limited to short-term salivary responses and did not include long-term clinical outcomes or systemic effects. By examining measurable changes under standardized conditions, this study aimed to evaluate the potential of hydroethanolic ginger extract as a natural sialogogue and its relevance in supporting oral health.

METHODS AND MATERIALS

Research Method

The researchers used a single-blinded, true experimental design with pre- and post-intervention measurements to determine the effects of hydroethanolic ginger extract on salivary parameters: flow rate, pH level, and buffering capacity.

Research Procedure

Recruitment of Participants

The target population consisted of fifth-year Doctor of Dental Medicine (DMD) students at Centro Escolar University–Manila who met the inclusion criteria. Participants were considered eligible if they were currently enrolled in the second semester of the 2025–2026 academic year at the Centro Escolar University–Manila School of Dentistry, aged 22 to 24 years, willing to participate, non-smokers, and practicing regular oral hygiene. Exclusion criteria included individuals with known hypersensitivity to ginger or any study material, those undergoing orthodontic or prosthodontic treatment, individuals currently taking medications, and those with a history of xerostomia or systemic diseases.

A total of 34 participants were selected from the pool of eligible individuals using simple random sampling. The sample size ($n = 34$) was determined using G*Power software based on a paired-samples t-test, assuming a large effect size ($d_z = 0.80$), a significance level of 0.05, and a desired statistical power of 85%. The selected participants were then randomly and equally assigned to either the control group or the experimental group. Participants were withdrawn from the study if they voluntarily chose to withdraw, failed to comply with study instructions or required tests, were absent during scheduled appointments, developed adverse reactions to the study materials or systemic symptoms during participation, began taking medications, violated ethical guidelines or study protocols, or were found to have a conflict of interest.

This group was selected because its members share a similar academic level and age range, are readily accessible to the researchers, and possess sufficient knowledge of oral health concepts and clinical procedures. Their clinical exposure and familiarity with standard oral procedures increased the likelihood of accurate compliance with the study protocol, including fasting instructions, oral rinsing, saliva expectoration, and the use of test strips.

Preparation of Control (Distilled Water) material

The control material consisted of medical-grade distilled water obtained from a trusted medical store.

Preparation of Experimental (Hydroethanolic Ginger Extract) material

The experimental intervention was a hydroethanolic extract of *Zingiber officinale* Roscoe rhizomes sourced from Antipolo, Rizal, and authenticated by the Bureau of Plant Industry. The rhizomes were washed, peeled, sliced, and dried at 50°C prior to pulverization. The powdered samples were soaked in a 70% ethanol and 30% distilled water solution (1:10 w/v) for 24 hours with periodic agitation, followed by filtration and concentration using a rotary evaporator. The resulting extract was diluted at a ratio of 0.2:10 (v/v) with distilled water to produce a final volume of 20 mL per sample, prepared on the day of experimentation to ensure stability.

Data Collection Procedure

The study was conducted at Centro Escolar University–Manila, with data collection carried out in the Oral Diagnosis Section of the Dentistry building. It involved a single data collection session with pre- and post-intervention sampling points and employed a single-blinded nature of experimentation. Standardized conditions for both groups included 30 minutes of fasting, followed by oral prophylaxis and an additional 30 minutes of rest with minimal oral movement.

For baseline data collection, participants were instructed to swallow residual saliva before expectorating every minute into a pre-calibrated plastic measuring cup over a 5-minute period to determine salivary flow rate. A 2-in-1 pH and buffering capacity test strip was then placed in the mouth for ten seconds after the final expectoration, retrieved, and recorded by the examiner in accordance with the manufacturer's instructions.

For the intervention, 20 mL of the assigned material (distilled water for the control group and hydroethanolic ginger extract for the experimental group) was placed in the mouth and swished for 60 seconds before being expectorated into a designated paper cup. Participants were then instructed to expectorate every minute for a 5-minute period into another pre-calibrated plastic measuring cup to determine post-intervention salivary flow rate. The 2-in-1 test strip was subsequently placed in the mouth for ten seconds immediately after the final expectoration to measure and record post-intervention pH and buffering capacity.

Data Analysis and Statistical Treatment

Data were organized, verified, and grouped into control and experimental categories with corresponding pre- and post-intervention measurements. Descriptive statistics, including mean and standard deviation, were used to summarize salivary flow rate, pH, and buffering capacity. Inferential analysis was

conducted using paired t-tests to determine within-group differences and independent t-tests to assess differences between groups. Statistical analysis was conducted at a 95% confidence level, with the level of significance set at $p < 0.05$, using the Statistical Package for the Social Sciences (SPSS).

Ethical Considerations

The study was conducted following approval from the Institutional Ethics Review Board (IERB). Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and participants had the right to withdraw at any time. Confidentiality and anonymity of all participant data were strictly maintained throughout the study.

RESULTS AND DISCUSSION

Results

The results of the study are summarized in the following statistical tables, showing changes in salivary parameters after oral swishing interventions in both the control and experimental groups.

The findings are presented using descriptive and inferential statistical analyses to determine changes within and between groups.

Table 1 presents the mean salivary parameters at baseline and post-intervention for both the control (distilled water) and experimental (ginger hydroethanolic extract) groups ($n = 17$ each). In terms of salivary flow rate and pH, both groups

showed increases in mean values after intervention, with more pronounced improvements observed in the experimental group compared to the control group. In contrast, the mean buffering capacity decreased in the control group, while it increased in the experimental group, indicating an overall improvement following ginger intervention.

A dependent t-test (Table 2) showed a significant increase in salivary flow rate in the control group, from 0.90 mL/min (SD = 0.25) at baseline to 1.12 mL/min (SD = 0.27) after distilled water swishing ($t = -3.326$, $p = 0.004$), indicating a statistically significant effect of the intervention. In the experimental group, salivary flow rate also increased from 0.82 to 1.48 mL/min, reflecting a marked improvement following ginger hydroethanolic extract intervention.

An independent t-test further demonstrated a significant difference between groups (Table 2) ($t = 3.640$, $p = 0.001$), with the experimental group showing a greater mean increase in salivary flow rate (0.66 mL/min, SD = 0.43) compared to the control group (0.22 mL/min, SD = 0.27), indicating a stronger effect of the ginger intervention.

In Table 3, dependent t-test showed no significant change in salivary pH in the control group after distilled water swishing ($t = -0.187$, $p = 0.854$), with a minimal increase from 7.44 (SD = 0.79) to 7.47 (SD = 0.87). In contrast, the experimental group showed a significant increase in salivary pH following ginger hydroethanolic extract swishing ($t = -2.509$, $p = 0.023$), with

Table 1. Mean of Participants' Salivary Parameters

	Control Group			Experimental Group		
	Baseline (Pre-Intervention)	After Intervention	Interpretation	Baseline (Pre-Intervention)	After Intervention	Interpretation
Salivary Flow Rate	0.90	1.12	Increased	0.82	1.48	Increased
Salivary pH	7.44	7.67	Increased	7.47	8.02	Increased
Buffering Capacity	560	500	Decreased	563.52	651.76	Increased

Table 2. Statistical Analysis of Salivary Flow Rate Result

Parameter	Test Type	Group	Baseline (Mean $\pm$ SD)	After (Mean $\pm$ SD)	t-value	p-value	Decision	Remarks
Salivary Flow Rate	Dependent t-test	Control	0.90 $\pm$ 0.25	1.12 $\pm$ 0.27	-3.326	0.004	Reject Ho	Significant
	Dependent t-test	Experimental	0.82 $\pm$ 0.38	1.48 $\pm$ 0.60	-6.395	<0.001	Reject Ho	Significant
	Independent t-test	Control vs Experimental	0.22 $\pm$ 0.27	0.66 $\pm$ 0.43	3.640	0.001	Reject Ho	Significant

Table 3. Statistical Analysis of Salivary pH Level Result

Parameter	Test Type	Group	Baseline (Mean $\pm$ SD)	After (Mean $\pm$ SD)	t-value	p-value	Decision	Remarks
Salivary pH Level	Dependent t-test	Control	7.44 $\pm$ 0.79	7.47 $\pm$ 0.87	-0.187	0.854	Do Not Reject Ho	Not Significant
	Dependent t-test	Experimental	7.68 $\pm$ 0.75	8.03 $\pm$ 0.76	-2.509	0.023	Do Not Reject Ho	Significant
	Independent t-test	Control vs Experimental	0.03 $\pm$ 0.65	0.35 $\pm$ 0.58	1.533	0.135	Do Not Reject Ho	Not Significant

Table 4. Statistical Analysis of Buffering Capacity Result

Parameter	Test Type	Group	Baseline (Mean $\pm$ SD)	After (Mean $\pm$ SD)	t-value	p-value	Decision	Remarks
Buffering Capacity	Dependent t-test	Control	560.00 $\pm$ 9.62	528.24 $\pm$ 271.57	0.453	0.657	Do Not Reject Ho	Not Significant
	Dependent t-test	Experimental	563.53 $\pm$ 3.60	651.76 $\pm$ 195.84	-1.848	0.083	Do Not Reject Ho	Not Significant
	Independent t-test	Control vs Experimental	-31.76 $\pm$ 289.40	88.24 $\pm$ 196.86	1.414	0.167	Do Not Reject Ho	Not Significant

mean values rising from 7.68 (SD = 0.75) to 8.03 (SD = 0.76), indicating a shift toward alkalinity.

However, an independent sample t-test (Table 3) revealed no significant difference in pH change between groups ($t = 1.533$, $p = 0.135$). Although the experimental group showed a higher mean change (0.35, SD = 0.58) compared to the control group (0.03, SD = 0.65), this difference was not statistically significant.

The dependent t-test in Table 4 showed no significant change in salivary buffering capacity after distilled water swishing in the control group ($t = 0.453$, $p = 0.657$), with a slight decrease from 560.00 (SD = 9.62) to 528.24 (SD = 271.57). Similarly, the experimental group showed no significant change after ginger hydroethanolic extract swishing ($t = -1.848$, $p = 0.083$), despite an increase from 563.53 (SD = 3.60) to 651.76 (SD = 195.84).

Furthermore, an independent sample t-test (Table 4) revealed no significant difference in salivary buffering capacity between groups ($t = 1.414$, $p = 0.167$). The control group had a mean change of -31.76 (SD = 289.40), while the experimental group showed a mean change of 88.24 (SD = 196.86), indicating that the observed differences were not statistically significant.

DISCUSSION

Across all measured parameters, both the control and experimental groups demonstrated observable changes following oral swishing, although the extent and consistency of these effects differed between interventions.

Regarding salivary flow rate, both groups demonstrated an increase, with a more pronounced elevation observed in the experimental group. Post-intervention values remained within the normal stimulated range (1.5–2.0 mL/min), indicating that both interventions were sufficient to elicit a physiological salivary response (Edgar et al., 2012).

This response is primarily attributable to mechanical stimulation induced by oral swishing, which activates reflex salivary secretion through autonomic pathways (Mary & Cherian, 2020; Dong & Chen, 2022; Zagvazdin et al., 2024). Even neutral solutions such as distilled water can stimulate salivation, although to a lesser extent than chemically active agents (Yu & Fang, 2024; Nurfadilla et al., 2024).

The greater response observed in the experimental group is likely due to the presence of ginger bioactive compounds, particularly gingerols and shogaols, which enhance gustatory-salivary reflex activity and promote parasympathetic-mediated secretion, thereby augmenting salivary output (Gao et al., 2022; Wongkolasin et al., 2023; Badooei et al., 2021; Jumain et al., 2022). For salivary pH, both groups exhibited values above the normal physiological range (6.2–7.2), indicating a shift toward alkalinity (Bechir et al., 2021). The experimental group demonstrated a greater increase compared with the control group, suggesting a more pronounced alkalizing effect associated with ginger hydroethanolic extract. This effect may be explained by enhanced salivary flow and increased bicarbonate concentration in stimulated saliva, which improves buffering capacity and

facilitates acid neutralization within the oral cavity (Sahni et al., 2023).

However, the absence of a statistically significant between-group difference suggests that pH variations may also reflect inherent physiological fluctuations in salivary regulation (Bechir et al., 2021). In contrast, salivary buffering capacity remained stable across conditions, with no statistically significant changes observed within or between groups. Although the experimental group showed a non-significant increase, these changes were insufficient to indicate a definitive intervention effect.

Overall, the findings show that ginger hydroethanolic extract significantly affected salivary flow rate, while no significant changes were observed in salivary pH and buffering capacity. This suggests that the extract mainly stimulates saliva production but does not alter saliva's chemical properties. The stability of pH and buffering capacity reflects the strong regulatory

control of the body's natural buffering system. Therefore, the intervention appears to influence salivary flow rate only, with little to no effect on salivary pH and buffering function.

CONCLUSION

Hydroethanolic extract of ginger (*Zingiber officinale* Roscoe) resulted in a more pronounced increase in salivary flow rate compared to distilled water. However, it caused only a minimal change in salivary pH, which was not distinctly different from the control, suggesting a limited effect under short-term exposure. Salivary buffering capacity also remained largely stable, highlighting the stability of saliva's natural acid-neutralizing systems. Overall, the hydroethanolic ginger extract shows promise as a natural salivary stimulant through both mechanical and chemical pathways, while exerting little influence on salivary pH and buffering capacity. The enhanced salivary flow may contribute to better oral lubrication and support the removal of food particles and microorganisms.

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The Philippine Dental Association, Inc.

Dental Caries Preventive and Interceptive Management Evidence-based Guidelines for the General Practicing Dentists Adapted from American Dental Association (ADA), (2013/2018/2024), and Scottish Intercollegiate Guidelines Network, (2014) Guidelines

Marie Arlene Christine T. Valerio, DMD, MHPed¹
Mya Win Hnit, MBBS, MSc.CM-FM²
Alvin M. Laxamana, DMD, PhD³

Michelle Sunico-Segarra, DDM, MOH, PhD⁴
Maria Jacinta Rosario H. Romero, DDM, PhD⁴
Aaron Paul T. Baliga, MSc⁵

¹Centro Escolar University, Manila

²Myanmar Academy of Family Physicians, Myanmar

³University of Perpetual Help, Laguna

⁴University of the Philippines, Manila

⁵Philippine Normal University, Manila

*Non author contributors:

Maritess Oliveros-Villarico, DDM, MFLCD, PhD¹

Vicente O. Medina III, DDM, PhD¹

Artemio R. Licos Jr., DMD, DrPH²

Simonne Salazar-Ferraris, DMD, PhD³

¹University of the Philippines, Manila

²Don Mariano Marcos Memorial State University, Ilocos Norte

³Centro Escolar University, Makati City

EXECUTIVE SUMMARY

INTRODUCTION

1.1 Global Burden and Clinical Impact

Dental caries, commonly referred to as tooth decay or dental cavities, is the most prevalent noncommunicable disease (NCD) worldwide, affecting more than 2.5 billion people (Li et al., 2025). Despite being largely preventable through timely and evidence-based preventive intervention, dental caries continue to pose a significant public health challenge, affecting individuals across the lifespan (World Health Organization, 2023).

Beyond its localized effects on the dentition, dental caries has been associated with systemic inflammation, particularly among adolescents (Costa et al., 2026). When left untreated or inadequately managed, the disease may result in a wide range of clinical, functional, and psychological consequences. These include acute discomfort, chronic pain, periodontal

complications, systemic infection, impaired mastication and sleep, as well as psychological distress manifested by anxiety and depression from low self-esteem and social isolation (World Health Organization, 2023; Asiri et al., 2024). Progressive disease may ultimately lead to irreversible tooth loss and substantial impairment in oral health-related quality of life (OHRQoL), while imposing considerable economic and healthcare burdens on individuals and healthcare systems.

1.2 The Socioeconomic Gradient and Oral Health Inequity

The distribution of oral diseases is strongly influenced by the social determinants of health, disproportionately affecting individuals and communities experiencing socioeconomic disadvantage. A consistent and well-documented socioeconomic gradient exists in the prevalence and severity of dental caries, with lower income, educational attainment, and occupational status being associated with poorer oral

health outcomes (WHO, 2022). Globally, a remarkably robust and consistent gradient exists between socioeconomic status (measured through income, occupation, and educational attainment) and both the prevalence and severity of dental caries (WHO, 2022).

These disparities persist throughout the life course, from early childhood to older adulthood, and are observed across the low-, middle-, and high-income countries. In developing healthcare systems such as the Philippines, oral health inequities are further compounded by limited access to essential oral healthcare services, inequitable distribution of preventive programs, financial barriers to care, and variations in oral health literacy (Williams, 2014; Lai et al., 2025). Addressing these social and structural determinants is therefore fundamental to reducing the burden of dental caries and achieving equitable oral health outcomes.

1.3 Rationale for the Philippine Clinical Practice Guidelines (CPGs)

As oral healthcare in the Philippines continues to evolve in response to advances in clinical science, digital technologies, and changing population health needs, there is an increasing imperative to shift from predominantly restorative, treatment-oriented approaches toward preventive, minimally invasive, and evidence-based models of care. Addressing the persistent burden of dental caries requires coordinated strategies that emphasize disease prevention, early detection, risk-based management, and equitable access to effective interventions.

The Clinical Practice Guidelines (CPGs) for the Preventive and Interceptive Management of Dental Caries were developed to provide evidence-based recommendations that support consistent, high-quality clinical decision-making across diverse healthcare settings. By systematically synthesizing the best available evidence and contextualizing it to the Philippine healthcare system, socioeconomic conditions, cultural factors, and available resources, these guidelines aim to reduce unwarranted variations in clinical practice, improve patient outcomes, promote efficient use of healthcare resources, and advance oral health equity nationwide.

REGULAR DENTAL VISITS

As we promote preventive care, regular dental visits are essential. To provide evidence on the importance of regular dental visits, a systematic review and meta-analysis of existing literatures were conducted in 2025.

This systematic review aimed to answer the following clinical question, “Among the general population (children and adults), how effective are regular dental visits in improving oral health?”

A systematic search of electronic databases including MEDLINE

(PubMed), Scopus, Web of Science, Dentistry & Oral Sciences Source (EBSCOhost), and HERDIN Plus+ was done using the keywords summarized in Table 1 below.

Table 1. Keywords and synonyms

Adults and children	Regular dental visit	Oral health
Children	Routine dental visit	Dental health
Adolescents	Dental health service*	Oral hygiene
Teenagers	Dental check-up	Oral health status
Youth/ Minors	Dental visit frequency	Dental caries incidence
Young adults	Preventive dental visit	Periodontal health OR Gingival health
Old adults	Dental care utilization	DMFT index
Adult population	Dental attendance	Plaque index
	Oral/ Dental screening	

A total of 5992 records were found, and 1511 were screened by two independent reviewers after removing the ineligible records and duplicates using Excel. Only six relevant papers (one randomized control trial, one prospective cohort study, three retrospective cohort studies and one retrospective analysis study) were included in the data extraction and final analysis.

Populations of included studies are children from 2 years old to adults and geriatric patients up to 89 years old with a total of **30,383** population. The included studies compared the result of oral health of patients who attended regular dental visits, or those with preventive care patterns compared to patients with no visit, no utilization of dental services or no attendance, delayed visits, irregular visits or those who only received symptom-driven dental care. This means that these patients with poor attendance to the dentists did not receive or may have poor exposure to oral health education, fluoride application, systematic screening and referral. The outcomes assessed are oral hygiene, dental caries experience, tooth loss and Oral Health Related Quality of Life (OHRQoL).

The results of the systematic review and meta-analysis show that regular dental visits have a long-term impact on oral health. Children who received routine dental care experienced fewer oral symptoms and enjoyed better oral health-related quality of life compared to non-routine attenders. Children monitored regularly showed a significantly lower risk of developing early-stage active cavities (initial lesions), and heavy plaque accumulation. Patients with irregular dental attendance habits,

including those who never attend regularly or stopped doing so, experienced significantly higher rates of tooth decay, and had more missing teeth than those who maintain consistent, lifelong regular visits (Aldossary A et al. 2014; Khairuddin et al. 2024; Berti et al. 2021; Giannobile et al. 2013; Menegazzo et al. 2020; Haukka et al. 2023).

Establishing regular dental visits during childhood is associated with sustained oral health benefits that extend into adulthood. Early and consistent engagement with preventive dental care contributes to improved oral health outcomes in later life and facilitates the adoption of lifelong oral health behaviors. These long-term benefits are particularly important for children experiencing socioeconomic or behavioral disadvantages, including those with lower parental educational attainment or inadequate oral hygiene practices during childhood, who are at greater risk of developing dental caries and other oral diseases (Aldossary A et al. 2014; Khairuddin et al. 2024; Berti et al. 2021; Giannobile et al. 2013; Menegazzo et al. 2020; Haukka et al. 2023).

Although regular dental attendance is an important component of preventive oral healthcare, the clinical benefits of recall visits are determined primarily by the quality and appropriateness of the preventive interventions delivered during each encounter rather than by the frequency of attendance alone (Fee et al., 2020). Evidence from large longitudinal cohort studies indicates that routine six-month recall intervals, when applied uniformly to all patients, do not consistently reduce the incidence of dental caries. Instead, improved clinical outcomes are achieved through individualized, risk-based recall strategies that integrate comprehensive caries risk assessment, patient-centered education, preventive interventions, and shared decision-making between the clinician and patient (Clarkson et al., 2020). Accordingly, the effectiveness of recall visits depends on the delivery of personalized preventive care tailored to each patient's level of caries risk rather than adherence to a fixed recall interval.

CARIES RISK ASSESSMENT (CRA)

Caries risk assessment is a fundamental component of evidence-based caries management. Identifying an individual's risk of caries development and progression enables clinicians to implement targeted preventive interventions, optimize resource allocation, and deliver cost-effective oral healthcare (Scottish Intercollegiate Guidelines Network [SIGN], 2014).

When performing caries risk assessment, clinicians should consider the following patient-specific factors:

- **Previous caries experience and clinical evidence of disease**, including existing restorations, active carious lesions, and history of caries progression.
- **Dietary habits**, with particular emphasis on the frequency and pattern of free sugar-containing food and beverage

consumption.

- **Fluoride exposure**, including the use of fluoridated toothpaste, professionally applied fluoride, fluoridated water, and other fluoride-containing products.
- **Oral hygiene and plaque control practices**, including the effectiveness and consistency of daily plaque removal.
- **Salivary factors**, including salivary flow rate, buffering capacity, and conditions associated with salivary dysfunction.
- **Medical history**, including systemic diseases, medications, and other conditions that may increase the risk of dental caries.

Dentists should identify patients with underlying medical conditions or physical disabilities who are at increased risk of adverse health consequences from dental caries. These patients should receive enhanced, individualized preventive care based on comprehensive caries risk assessment and their underlying medical condition (SIGN, 2014).

While the above-mentioned factors can affect caries risk, the patient's previous caries experience and current oral health status are the strongest predictors of likelihood of future caries development (Fontana, et al., 2024).

Risk Levels

• Low Risk (The Standard Baseline)

Assigned to patients with no active carious lesions, good oral hygiene, regular exposure to fluoride, low frequency of free sugar consumption, and consistent adherence to routine preventive oral healthcare. This category represents the expected baseline level of caries risk.

• Moderate Risk

Assigned to patients who exhibit a balance of protective and risk factors or present with one or more risk factors (e.g., inadequate oral hygiene or reduced salivary flow) but have no evidence of recently developed active carious lesions. These individuals require individualized preventive interventions and periodic reassessment of caries risk.

• High Risk (Increased Risk)

Assigned to patients with clear indicators of active disease or a high likelihood of disease progression, including multiple active carious lesions or a recent history of dental caries (e.g., three or more carious lesions within the previous three years), visible plaque accumulation, frequent consumption of free sugars, xerostomia, or other significant biological or behavioral risk factors. These individuals should receive intensive, risk-based preventive and therapeutic management with appropriately scheduled recall visits.

Recommendations:

Clinicians should perform a caries risk assessment (CRA) during every routine oral examination to guide the selection of individualized preventive and therapeutic interventions.

PRECISE IDENTIFICATION, ASSESSMENT, AND MONITORING OF CARIES LESIONS

To safely choose and succeed with preventive and conservative therapies, clinicians must build on a clear foundation: combining an initial caries risk assessment with the accurate identification, staging, and long-term tracking of the decay itself (Slayton et al., 2018).

Caries Lesion Severity Classification

*This is based on the **International Caries Detection and Assessment System (ICDAS)** and the **International Caries Classification and Management System (ICCMS™)** frameworks.

For these guidelines, the following terms are defined for better understanding:

- **ICDAS Code 0 (Sound Tooth)**
There is no visual evidence of dental caries (either no change or no questionable change in enamel translucency) after a clean surface has been air-dried for 5 seconds. Tooth surfaces with developmental defects (such as enamel hypoplasia, fluorosis, or extrinsic staining) are still classified as sound if they show no signs of cariogenic demineralization.
- **ICDAS Codes 1–2 (Noncavitated / Initial Stage Lesions)**
These represent early-stage, visually intact enamel surfaces experiencing mineral loss. Code 1 is characterized by the first visual change in enamel (a faint opacity or discoloration) that is only visible after prolonged air drying. Code 2 is characterized by a distinct visual change in enamel (white or brown spot lesion) that is clearly visible even when the tooth surface is still wet.
- **ICDAS Codes 3–4 (Moderate Stage Caries)**
These represent intermediate-stage lesions where demineralization has progressed beyond early enamel loss but has not yet reached extensive cavitation.
- **ICDAS Code 3 (Localized Enamel Breakdown)**
This is characterized visually by a distinct white or brown spot lesion that has developed a micro-cavity, crack, or surface discontinuity within the enamel, but with **no visible dentin** exposure. This early physical breakdown is often viewed best when the tooth surface has been thoroughly air-dried.

- **ICDAS Code 4 (Underlying Dark Shadow from Dentin)**
This is characterized by an intrinsic gray, blue, or brown shadow of discolored dentin reflecting through an intact or micro-fractured enamel surface. This underlying dentinal decay is distinct from surface staining and is often best seen when the tooth surface is completely wet.
- **ICDAS Codes 5–6 (Cavitated / Extensive Stage Lesions)**
These represent advanced dental decay with a distinct breakdown of the tooth structure. Code 5 is characterized by a distinct cavitation exposing visible dentin that involves less than half of the tooth surface. Code 6 represents extensive, deep cavitation where the visible dentin breakdown involves half or more of the entire tooth surface.

Caries Lesion Severity and Activity and its recommended management (Fortana et al., 2024)

- **Inactive or arrested noncavitated and cavitated lesions**
Inactive or arrested caries lesions generally do not require operative caries treatment, as there is no evidence of ongoing disease activity. Management should focus on maintaining lesion arrest through continued preventive care and periodic monitoring. Restorative intervention may be considered when indicated to restore tooth form, function, or esthetics.
- **Active noncavitated caries lesions**
Active noncavitated caries lesions, including active white-spot or brown-spot lesions and radiographic lesions confined to enamel or extending into the outer one-third of dentin, should be managed using nonrestorative approaches. Appropriate interventions include topical fluoride therapy, pit and fissure sealants where indicated, resin infiltration, dietary counseling, oral hygiene reinforcement, and individualized caries risk management to promote lesion arrest or reversal.
- **Cavitated caries lesions**
Active cavitated caries lesions are generally not self-cleansable and typically exhibit ongoing disease activity characterized by plaque retention and infected dentin. Management should aim to arrest disease progression, preserve tooth structure whenever feasible, and restore form and function using minimally invasive, evidence-based operative interventions in conjunction with preventive measures to reduce the risk of future disease.

Recommendations:

Diagnosis of dental caries should be based on a comprehensive clinical assessment that integrates visual examination, gentle tactile assessment using a blunt-ended probe, and adjunctive diagnostic tools (radiograph, intra-oral photos,

laser fluorescence), when clinically indicated, to improve the detection and assessment of caries lesions.

Caries lesions should be monitored periodically because lesion activity and disease progression may change over time in response to oral hygiene practices, fluoride exposure, dietary habits, and other patient-specific risk factors. Regular reassessment enables timely modification of preventive and therapeutic interventions according to the patient's current caries risk and lesion status.

CORE RECOMMENDATIONS: DENTAL CARIES PREVENTION

The following recommendations are adapted from ADA 2013 and SIGN 2014 (Weyant et al., 2013; SIGN, 2014).

Goal: Prevent the onset of dental caries on sound tooth surfaces.

Given that dental caries is multifactorial in initiation and progression, no single material or intervention should be regarded as the sole solution. Instead, preventive strategies should be individualized and combined according to patient risk, clinical presentation, accessibility, and long-term oral health goals.

A. Topical Fluoride Therapy

The following recommendations aimed to answer this question:

In primary and permanent teeth, does the use of a topical fluoride agent reduce the incidence of new lesions in coronal caries, root caries or both compared with no topical fluoride use?

When used in patients who are at an elevated risk for developing tooth decay, professionally applied and prescription-strength topical fluoride agents significantly reduce the incidence of new lesions in both coronal (crown) caries and root caries compared to using no topical fluoride.

Fluoride gels or varnishes can be professionally applied every 3 through 6 months for four minutes; due to their high fluoride concentration, these products form tooth-bound fluoride reservoirs that will be released over time, allowing for less frequent use. Both must remain in contact with the tooth for a prolonged period to ensure adequate time for fluoride release and reactivity with the tooth surface.

The use of professionally applied fluoride should be considered part of a personalized caries management plan for people at an increased risk of developing caries and not merely prescribed to every patient when professional prophylaxis is performed.

5% Sodium Fluoride (NaF) varnish (22,600 ppm)

Fluoride varnish should be applied at least twice yearly in all children and individuals at increased risk of dental caries as part of a comprehensive, risk-based preventive strategy. Varnish is the only high fluoride topical agent recommended for children younger than 6 years.

Remarks

Obvious deposits of dental plaque should be removed prior to application. In order not to exceed the Probable Toxic Dose (PTD), clinicians should use a thin film using a minimal amount on caries predilection sites, initial caries lesions and defects. Instruct the child not to eat or drink for 20-30 minutes after application (Toumba et al., 2019).

1.23% Acidulated Phosphate Fluoride (APF) gel

High-concentration fluoride gels may be applied to teeth with the aim of preventing dental caries and remineralising early caries lesions.

The comparatively high frequency of applications needed (monthly or bi-monthly) to achieve the caries reductions reported, along with the time needed to construct appliances and the time taken in application to allow use of the gels make the practicalities of this modality a considerable barrier to its use. APF gel is not recommended for children below 6 years of age due to high risk of swallowing the gel. Use 2-4 times per year.

Remarks

In dental practice, remove obvious deposits of dental plaque and choose appropriate size trays. Gels are applied to the teeth in disposable trays which fit loosely over the teeth. Patients should sit in upright position and avoid swallowing; use suction devices during the treatment and after tray removal to minimise swallowing. Instruct children not to eat or drink for 20-30 minutes after application (Toumba et al., 2019).

Fluoride mouthwash, with fluoride at concentrations of 250 ppmF

It is often a key component of OTC daily mouthwashes. Fluoride at higher concentration, if made available in the Philippine market, should be through special prescriptions and is recommended for patients 6 years or older.

Remarks

Supervised use (by parents or at school) is more efficacious than unsupervised. 10 ml of the solution is swished around the mouth for 1 minute. Instruct the child not to eat or drink for 20-30 minutes after application. Should be used for prevention of caries in both primary and permanent teeth (Toumba et al., 2019).

B. Pit and Fissure Sealants

The following recommendations aimed to answer this question:

In primary and permanent teeth, does the use of pits and fissure sealant reduce the incidence of new lesions in coronal caries compared with no use?

Strong evidence recommends sealants for the occlusal (chewing) surfaces of both primary and permanent molars in children and adolescents who are determined to be at risk for tooth decay.

A fissure sealant is a protective plastic coating which is applied by a dentist to the biting surfaces of the back teeth, forming a hard shield that keeps food and bacteria from getting into the tiny grooves in the teeth and causing decay. Sealants have been in use for over 50 years and are available as resin-based or glass ionomer compounds.

Resin-based or Glass Ionomer sealants

May be placed on sound or non-cavitated pits and fissures of permanent molars in children and adolescents at risk for caries.

Both resin composite and glass ionomer cement sealants are recognized for their caries-controlling capabilities. When selecting between these materials, factors like anticipated retention longevity (resins typically exhibit superior retention compared with glass ionomer cement) and the capacity to achieve a moisture-controlled environment during application (glass ionomer cement is more tolerant to moisture) should be considered

Remarks

Resin-based fissure sealants should be applied to the permanent molars of all children as early after eruption as possible and the teeth can be properly isolated, preferably with a rubber dam. Resin-based sealants are preferred when moisture control is optimal; use glass ionomer if complete isolation is impossible. Glass ionomer sealants may be considered if the application of a resin-based sealant is not possible.

Sealants should be applied to permanent molars within one year of eruption which usually takes place between the ages of six to seven years for first molars and 11–12 years for second molars. There is a degree of variability, however, in the age of eruption for individual children which can be anywhere from five to nine years of age for first molars and eight to 14 years for second molars.

The American Dental Association guidelines emphasized meticulous moisture control and optimal surface cleaning to maximize sealant retention, advising against routine mechanical tooth preparation. Recommended procedures included 35–37% phosphoric acid etching, the application of bonding agents, and

thorough inspection for voids, with a specific focus on utilizing four-handed dentistry techniques.

Placement techniques for pit-and-fissure sealants may vary based on sealant type and the manufacturer or brand. Manufacturers' instructions usually detail cleaning and isolation of the occlusal surface and encourage a dry environment during sealant placement and curing. Acid etching of occlusal surfaces is required before resin-based sealant placement.

CORE RECOMMENDATIONS: DENTAL CARIES INTERCEPTIVE MANAGEMENT (NON-RESTORATIVE MANAGEMENT)

The following recommendations are adapted from ADA, 2018, 2024 (Slayton et al., 2018; Fontana et al., 2024).

Goal: Arrest, reverse, or remineralize non-cavitated lesions; manage early-stage cavitated lesions minimally.

A. Interventions for Noncavitated Lesions for Both Primary and Permanent Teeth

The following recommendations aimed to answer this question:

To arrest or reverse noncavitated coronal carious lesions on primary or permanent teeth, should we recommend NaF, stannous fluoride, acidulated phosphate fluoride (APF), difluorsilane, ammonium fluoride, polyols, chlorhexidine, calcium phosphate, amorphous calcium phosphate (ACP), casein phosphopeptide (CPP)eACP, nano-hydroxyapatite, tricalcium phosphate, or prebiotics with or without 1.5% arginine, probiotics, SDF, silver nitrate, lasers, resin infiltration, sealants, sodium bicarbonate, calcium hydroxide, or carbamide peroxide?

The sequence of interventions presented in this guideline reflects a priority ranking established by the expert panel. This specific ordering balances clinical efficacy alongside practical feasibility, financial resource demands, and the unique preferences and values of the patients.

Occlusal Surfaces

Recommendations:

To arrest or reverse noncavitated carious lesions on occlusal surfaces of primary teeth, the expert panel recommends clinicians to:

- prioritize the use of sealants plus 5% NaF varnish (application every 3-6months)
- or sealants alone over 5% NaF varnish alone (application every 3-6 months),
- 1.23% APF gel (application every 3-6 months),
- resin infiltration plus 5% NaF varnish (application every 3-6 months),
- or 0.2% NaF mouthrinse (once per week)

(Moderate-certainty evidence)

To arrest or reverse noncavitated carious lesions on occlusal surfaces of permanent teeth, the expert panel recommends clinicians to:

- prioritize the use of sealants plus 5% NaF varnish (application every 3-6 months)
- or sealants alone over 5% NaF varnish alone (application every 3-6 months),
- 1.23% APF gel (application every 3-6 months),
- or 0.2% NaF mouthrinse (once per week).

(Moderate-certainty evidence)

Remarks

To mitigate the risk of experiencing accidental ingestion of high doses of fluoride, 0.2% NaF mouthrinses are not appropriate for uncooperative children who cannot control swallowing. In addition, in-office gels (for example, 1.23% APF gel) require suction to minimize swallowing, especially when used in children.

Approximal Surfaces

Recommendations:

To arrest or reverse noncavitated carious lesions on approximal surfaces of primary and permanent teeth, the expert panel suggests clinicians to:

- use 5% NaF varnish (application every 3-6 months),
- resin infiltration alone, or resin infiltration plus 5% NaF varnish (application every 3-6 months),
- or sealants alone.

(Low- to very-low-certainty evidence)

Remarks

When managing interproximal decay where physical tooth separation for direct visual inspection is impractical, radiographic depth serves as the primary diagnostic tool to estimate whether a lesion is intact or cavitated. The underlying clinical data evaluated lesions showing radiographic radiolucencies stretching from the enamel layer down into the superficial outer third of the dentin. The panel notes that lesions confined to these radiographic boundaries (enamel up to the outer third of the dentin) are predominantly noncavitated. Consequently, practitioners should default to conservative, nonrestorative therapies for these cases.

Facial or Lingual Surfaces

Recommendations:

To arrest or reverse noncavitated carious lesions on facial or lingual surfaces of primary and permanent teeth, the expert panel suggests clinicians to:

- use 1.23% APF gel (application every 3-6 months)
- or 5% NaF varnish (application every 3-6 months).

(Moderate- to low-certainty evidence)

Remarks

The use of professional in-office topical applications, such as 1.23% APF gel, necessitates continuous, active suctioning to prevent accidental ingestion, a safety measure that requires heightened vigilance when treating uncooperative pediatric patients.

Noncavitated Lesions on Any Coronal Tooth Surface

Recommendation:

To arrest or reverse noncavitated carious lesions on coronal surfaces of primary and permanent teeth, the expert panel suggests clinicians do not use 10% CPP-ACP if other fluoride interventions, sealants, or resin infiltration is accessible.

(Low-certainty evidence)

Remarks

The panel emphasizes that 10% CPP-ACP should not be used as a substitute for fluoride products.

No evidence was found on the effect of stannous fluoride, difluorsilane, ammonium fluoride, calcium phosphate, ACP, nano-hydroxyapatite, tricalcium phosphate, or prebiotics with or without 1.5% arginine, SDF, silver nitrate, lasers, sodium bicarbonate, calcium hydroxide, or carbamide peroxide for noncavitated lesions on any coronal tooth surface.

B. Interventions for Cavitated Lesions for Both Primary and Permanent Teeth

The following recommendations aimed to answer this question:

To arrest cavitated coronal carious lesions on primary or permanent teeth, should we recommend silver diamine fluoride, silver nitrate, or sealants?

The sequence of interventions presented in this guideline reflects a priority ranking established by the expert panel. This specific ordering balances clinical efficacy alongside practical feasibility, financial resource demands, and the unique preferences and values of the patients.

For the following recommendations, it is important that symptoms of irreversible pulpitis or pulpal disease/inflammation are first ruled out. Otherwise, the presence of these symptoms necessitates a different management (Slayton et al., 2018).

The application of SDF should be restricted to qualified dental professionals with appropriate training in its indications and application techniques. This recommendation is consistent with current international practice, where formal guidance for SDF use outside the dental profession remains limited (Holwe et al., 2021).

Advanced Cavitated Lesions on Any Coronal Tooth Surface

Recommendations:

To arrest advanced cavitated carious lesions on any coronal surface of primary teeth, the expert panel recommends clinicians to:

- prioritize the use of 38% SDF solution (biannual application) over 5% NaF varnish (application once per week for 3 weeks).

(Moderate-certainty evidence)

To arrest advanced cavitated carious lesions on any coronal surface of permanent teeth, the expert panel suggests clinicians to:

- prioritize the use of 38% SDF solution (biannual application) over 5% NaF varnish (application once per week for 3 weeks).

(Low-certainty evidence)

Remarks

While the available clinical trials exclusively measured the effectiveness of SDF in children with primary teeth, the expert panel did not expect SDF to have a substantially different effect when applied on coronal surfaces of permanent teeth. For this reason, the panel provided a strong recommendation for the use of 38% SDF solution in primary teeth and a conditional recommendation for its use on coronal surfaces of permanent teeth. This distinction stems from a complete absence of direct clinical data testing any SDF concentration on permanent teeth, which introduced significant concerns regarding indirectness of evidence.

Tactile assessment remains the standard for determining lesion inactivity, as a surface that feels firm or hard upon gentle probing indicates that the decay has successfully arrested. Conversely, relying purely on visual discoloration—such as a dark or black appearance—is an unreliable and unacceptable method for confirming lesion arrest.

A primary clinical side effect of silver diamine fluoride (SDF) is the permanent black staining of the treated tooth structure, a cosmetic outcome that may be objectionable to certain patients, parents, or family caregivers. To uphold the ethical standards of informed consent, practitioners must comprehensively explain all nonoperative and restorative pathways, ensuring that the potential risks, benefits, and aesthetic changes—specifically the distinctive blackening of enamel and dentin caused by SDF—are thoroughly discussed with the patient or guardian before initiating treatment.

C. Management of Root Surfaces (Permanent Teeth)

The following recommendations aimed to answer this question:

To arrest cavitated root carious lesions or arrest or reverse noncavitated root carious lesions on permanent teeth, should we recommend NaF, stannous fluoride, APF, difluorsilane, ammonium fluoride, polyols, chlorhexidine, calcium phosphate, ACP, CPP-ACP, nano-hydroxyapatite, tricalcium phosphate, or prebiotics with or without 1.5% arginine, probiotics, SDF, silver nitrate, lasers, resin infiltration, sealants, sodium bicarbonate, calcium hydroxide, or carbamide peroxide?

Cavitated & Noncavitated Root Lesions

To arrest or reverse noncavitated and cavitated carious lesions on root surfaces of permanent teeth, the expert panel suggests clinicians to:

- prioritize the use of 5,000 ppm fluoride (1.1% NaF) toothpaste or gel (at least once per day) over 5% NaF varnish (application every 3-6 months),
- 38% SDF plus potassium iodide solution (annual application),
- 38% SDF solution (annual application), or 1% chlorhexidine plus 1% thymol varnish (application every 3-6 months).

(Low-certainty evidence)

Remarks

While there is evidence on the effectiveness of 5,000 ppm fluoride (1.1% NaF) toothpaste or gel, this is not available in the Philippines and cannot be part of the recommendations.

No evidence was found on the effect of stannous fluoride, APF, ammonium fluoride, polyols, calcium phosphate, ACP, CPP-ACP, nano-hydroxyapatite, tricalcium phosphate, or prebiotics with or without 1.5% arginine, probiotics, silver nitrate, lasers, resin infiltration, sealants, sodium bicarbonate, calcium hydroxide, or carbamide peroxide for cavitated or noncavitated lesions on root surfaces.

Given that noncavitated and cavitated root lesions are difficult to distinguish in practice, the panel did not provide separate recommendations for these 2 types of lesions.

Summary table of products mentioned in these guidelines and its cultural adaptation for use in the Philippines.

While there is good evidence on the use of these products, the majority only receive conditional recommendations due to the FDA compliance, cost-effectiveness and availability in the local market.

Table 2. Summary of the Products, Strength of Recommendations and Cultural Adaptations for Clinical Use in the Philippines

Products	Strength of the Recommendations	Remarks
5% Sodium Fluoride (NaF) / Fluoride Varnish	Strong Recommendations	% NaF varnish has recently become available in the Philippines and is gaining popularity due to foreign evidence-based support for its caries preventive effectiveness. While brand-specific registration with the Food and Drug Administration Philippines should be verified, its increasing availability through dental traders supports procurement with emphasis to supervised clinical use only. The material is considered cost-effective as a preventive measure, requires minimal intervention due to its simple and non-invasive application, and is generally culturally acceptable as preventive oral care gains recognition among patients and dental practitioners.
1.23% Acidulated Phosphate Fluoride (APF) / Fluoride Gel	Conditional Recommendations	1.23% Acidulated Phosphate Fluoride (APF) has long been utilized in Philippine dental clinics, particularly before fluoride varnish became widely available, making it a familiar and evidence-based preventive option alongside stannous fluoride and sodium fluoride. While generally more affordable than fluoride varnish and likely compliant for clinical use subject to brand-specific registration with the Food and Drug Administration Philippines, its application is relatively technique-sensitive, which may limit ease of use for some clinicians. Despite this, APF remains culturally accepted due to its long-standing clinical presence and established preventive role in caries management. Its sustained availability in dental settings and relatively lower cost support favorable supply chain accessibility. But it's important to note that it is not recommended for children below 6 years of age.
0.2% NaF mouthrinse	Conditional Recommendations	0.2% NaF mouthwash may serve as a beneficial adjunct for high-risk patients by contributing to caries reduction, particularly when used alongside dentifrices and other preventive measures. However, its limited market availability in the Philippines may pose challenges in terms of supply chain accessibility and affordability, reducing its feasibility as a primary oral health preventive tool. While it may require minimal intervention due to ease of use and generally aligns with patient oral hygiene practices, its role is better suited as a supplementary preventive measure rather than a mainstay strategy. Brand-specific compliance with the Food and Drug Administration Philippines should also be verified if introduced for broader clinical use.
Pits and Fissure Sealants	Strong Recommendations	Pit and fissure sealants are considered one of the primaries in-clinic preventive strategies for dental caries, with substantial evidence supporting their effectiveness in reducing caries on occlusal and rough tooth surfaces. Their effectiveness, however, is highly dependent on operator skill and proper patient management to ensure adequate placement and retention. Sealants are generally widely available and accessible to private dental practitioners in the Philippines, with brand-specific compliance to the Food and Drug Administration Philippines recommended for clinical use. While the procedure requires minimal patient intervention, the overall cost may vary depending on material type and the professional fee associated with application, which may influence affordability and utilization.
Resin infiltration	Conditional Recommendations	Resin infiltration is an approved secondary preventive intervention that shows promise in preventing the progression of early non-cavitated lesions, particularly on approximal tooth surfaces, and in reducing the risk of white spot lesions becoming cavitated. While minimally invasive and clinically beneficial, its availability remains limited in the Philippines and the material is relatively expensive, which may affect supply chain accessibility and affordability. Although it may be culturally acceptable due to its tooth-preserving and aesthetic advantages, the cost of the procedure can be a significant concern for patients. As such, resin infiltration should not be considered the primary strategy for preventing white spot lesion progression but rather one of several preventive options integrated with established oral health measures and patient risk management.

38% Silver diamine fluoride (SDF)	Strong Recommendations for cavitated primary teeth Conditional Recommendations for non-cavitated lesions on primary teeth and carious lesions on permanent teeth	38% Silver Diamine Fluoride (SDF) is a relatively new addition to the dental market and has shown remarkable cost-effectiveness in arresting cavitated carious lesions based on foreign evidence-based studies. Recently approved by the Food and Drug Administration Philippines, it offers a minimally invasive approach to caries management, particularly for patients requiring non-restorative treatment options. However, its major drawback lies in the aesthetic concern of black staining on treated lesions, which may affect cultural acceptance among patients and practitioners. Although promising, wider adoption may still depend on dental practitioner acceptance, product availability, and affordability within the local market.
38% SDF solution plus Potassium Iodide	Conditional Recommendations	38% Silver Diamine Fluoride with Potassium Iodide (SDF-KI) is considered an improved version of conventional silver diamine fluoride, developed to address the aesthetic drawback of tooth discoloration associated with standard SDF treatment. As a minimally invasive and potentially cost-effective option for caries arrest, it may enhance patient acceptance while maintaining preventive benefits. However, despite its promising application, further studies are needed to better establish the long-term effectiveness and chemical interactions of the compound. Considerations regarding Food and Drug Administration Philippines registration status, market availability, practitioner acceptance, and affordability remain important for broader clinical adoption in the Philippines.
1% Chlorhexidine + 1% Thymol Varnish	Conditional Recommendations	1% Chlorhexidine + 1% Thymol varnish has potential benefits specific root caries management. However, as it is not yet approved by the Food and Drug Administration Philippines, its regulatory status limits broader clinical adoption in the Philippines. It should not be considered a primary preventive strategy for dental caries but rather a supplementary intervention alongside established preventive measures. Its relatively high cost and limited availability may affect accessibility and long-term patient compliance.
5,000 parts per Million (ppm) fluoride (1.1% NaF) toothpaste or gel	Not included due to lack of availability.	5000ppm fluoride toothpaste or gel delivers over 4 times the fluoride of regular over-the-counter toothpaste. This prescription-strength treatment is primarily used to reverse early cavities, stop root decay, and treat severe tooth sensitivity. But this is not available in the Philippines and therefore is not included in the recommendations.

For the above-mentioned materials, technique may vary depending on the manufacturer's guide.

Home Care Patient Instructions

The following recommendations are adapted from SIGN 2014.

- Following risk assessment, children and young people up to the age of 18 years who are at standard risk of developing dental caries should be advised to use toothpastes in the range 1,000 to 1,500 ppm.
- Following risk assessment, children up to the age of 10 years who are at increased risk of developing dental caries should be advised to use toothpastes at 1,500 ppmF.
- Following risk assessment, children aged from 10 to 16 years who are at increased risk of developing dental caries should be advised to use toothpastes with the highest concentration of fluoride available in the market.

Toothbrushing Best Practices

- Frequency & Duration: Brush at least twice daily for at least two minutes.
- Timing: Brush last thing at night before bedtime (maintains high salivary fluoride levels during lower nocturnal salivary flow) and on at least one other occasion.
- Post-Brush Technique: Spit, do not rinse with water. Rinsing significantly reduces the caries-preventive effect of fluoride toothpaste.
- Brush Selection: Either manual or powered toothbrushes are effective; no evidence proves powered options are superior at preventing caries.

Pediatrics and Supervision

Supervision of toothbrushing with fluoride toothpaste is

recommended as an effective caries prevention measure. Children who are unable to brush their teeth unaided should be assisted to do so.

- **Commencement:** Assist children to brush their teeth. Early intervention (before 2 years of age) yields the largest decrease in caries risk.
- **Supervision:** Mandatory supervision is recommended to regulate toothpaste volume and prevent young children from swallowing large amounts, lowering the risk of mild fluorosis.
- **Under 3 Years Old:** Use no more than a smear (approx. 0.1 mL) of toothpaste.
- **Over 3 Years Old:** Use a pea-sized amount (approx. 0.25 mL) of toothpaste.
- **Over 6 Years Old:** Use up to full length of brush (approx. 0.5-1mL) of toothpaste

Remarks

There is insufficient evidence on which to recommend a specific duration for an episode of toothbrushing for the prevention of caries.

The evidence regarding the effectiveness of flossing and other adjuncts for cleaning teeth in addition to toothbrushing for reducing dental caries in children is of insufficient quality and consistency to make a recommendation.

CONCLUDING STATEMENT: THE IMPERATIVE OF EVIDENCE-BASED DENTAL PRACTICE

The publication of this adapted Clinical Practice Guidelines marks a definitive step forward for the Philippine Dental Association and the general practicing dentists it represents. In the era where dental materials, technologies, and patient demographics are rapidly evolving, relying on historical anecdote or unsystematic clinical habits is no longer sufficient to guarantee optimal therapeutic outcomes.

Evidence-Based Practice (EBP) is not merely an academic exercise; it is an active ethical obligation to our patients. By systematically integrating the highest tier of global scientific data—such as the clinical recommendations synthesized by the ADA and the home-care promotion protocols established

by SIGN—with the local market realities and equity dynamics explored during the course of this research work, this guideline provides a practical blueprint for modern caries management.

When general practitioners implement these nonrestorative and preventive interventions at the chairside, the ultimate beneficiary is the patient. Transitioning from a traditional “drill-and-fill” philosophy toward an evidence-guided, risk-stratified approach ensures that sound tooth structure is preserved through validated primary prevention, effectively minimizing the lifelong cycle of restorative degradation. Under this framework, incipient lesions are managed aggressively yet minimally via evidence-backed remineralization, sparing patients unnecessary operative costs and discomfort. Furthermore, at-home care becomes highly precise by replacing generic advice with age-specific, ppm-targeted fluoride prescriptions that reduce the public burden of dental fluorosis while maximizing caries defense. Ultimately, this paradigm shift roots daily clinical choices in absolute transparency and equity, ensuring that the treatments recommended by general practicing dentists are both accessible to our local communities and fully justifiable under rigorous scientific scrutiny.

Ultimately, the true value of this guideline does not reside in its written manuscript, but in its active clinical implementation. The Philippine Dental Association calls upon all general practicing dentists nationwide to champion these evidence-based protocols. By embedding these standards into our daily diagnostic and therapeutic workflows, we elevate the quality, predictability, and safety of oral healthcare across the Philippines, ensuring that every patient receives care that is scientifically proven, ethically sound, and clinically exceptional.

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In order to ensure scientific objectivity and independence, the JPDA requires all the authors to make a full disclosure of areas of potential conflict of interest. Such disclosure will indicate whether the person and/or his/her immediate family has any financial relationship with pharmaceutical companies, medical equipment manufacturers, or any companies with involvement in the field of health care.

ETHICS REVIEW APPROVAL

For Original Articles, authors are required to submit a scanned soft copy of the Ethics Review Approval of their research. For manuscripts reporting data from studies involving animals. Authors are required to submit a scanned copy of the Institutional Animal Care and Use Committee approval.

INFORMED CONSENT UPDATE

For Case Reports, Images in dentistry, authors are required to submit scanned soft copy of signed informed consent for publication

from the involved subject/s (“Patient Consent Form”). In case the involved subject/s can no longer be contacted (i.e., retrospective studies, no contact information, et cetera) to obtain consent, the author must seek ethical clearance from the institutional board to publish the information about the subject/s.

GENERAL GUIDELINES

1. The manuscript should be encoded using Microsoft Word, double-spaced throughout with 1 ¼ cm (1/2 inch) paragraph indentation, with 3-cm margins (1 ¼ inch) all around on A4 size paper. The preferred font style and size is Times New Roman 12.
2. The manuscript should be arranged in sequence as follows: (1) Title Page, (2) Abstract, (3) Text, (4) References, (5) Tables, and (6) Figures & Illustrations.
3. References should pertain directly to the work being reported.
4. All the sheets of the manuscript should be labelled with the family name of the main author (all in capital letters) and page number (in Arabic Numerals) printed on the upper right corner.
5. All manuscripts not complying with the above shall be promptly returned for correction and resubmission.

Title Page

1. The Title should be as concise as possible
2. Only the full names of the authors directly affiliated with the work should be included (First name, Middle initial and Last name). There are 4 criteria for authorship:
 - 2.1 Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
 - 2.2 Drafting the work or revising it critically for important intellectual content; AND
 - 2.3 Final approval of the version to be published; AND
 - 2.4 Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
3. The highest educational attainment or title of the authors should be included as an attachment whenever appropriate.
4. Name and location of no more than one (1) institutional affiliation per author may be included.
5. If the paper has been presented in a scientific forum or convention, a note should be provided indicating the name, location and date of its presentation.

Abstract

For original articles, the abstract should contain no more than 200 words with a structured format consisting of the objective/s, methodology, results and conclusion. For feature articles, case reports, interhospital grand rounds and brief communications, the abstract should be from 50 to 75 words and need not be structured.

Keywords

At least 3 keywords but no more than 6 preferably using terms from the Subject Headings and should be listed horizontally under the abstract for cross-indexing of the article.

Text

1. Generally, the text should be organized consecutively as follows: Introduction, Methodology, Results and Discussion, and Conclusion (IMRAD format).
2. All references, tables, figures and illustrations should be cited in the text, in numerical order.
3. All abbreviations should be spelled out once (the first time they are mentioned in the text) followed by the abbreviation enclosed in parentheses. The same abbreviation may then be used subsequently instead of the long names.
4. All measurements and weights should preferably be in System International (SI) units.
5. If appropriate, information should be provided on institutional review board/ethics committee approval.
6. Acknowledgements to individual/groups, or institution/s should be included at the end of the text just before the references. Grants and subsidies from government or private institutions should also be acknowledged.

References

1. References in the text should be identified by Arabic.
2. References should be typed double-spaced. They should be alphabetized.

3. All references should provide inclusive page numbers.
4. Journal abbreviations should conform to those used in PubMed.
5. A maximum of six authors per article can be cited; beyond that, name the first three and add "et al."
6. The style/punctuation approved by JPDA conforms to APA format.

Journal Article

Padua FR, Paspe MG. Antinuclear antibody in the rheumatic and non-rheumatic diseases among Filipinos. *Acta Med Philippina*. 1990;26(2):81-85

One to Six Authors (Commentary, Online)

Krause RM. The origin of plague: old and new. *Science*. 1992;257:1073-1078

Barry JM. The site of origin of the 1918 influenza pandemic and its public health implications. [Commentary]. *JTranslational Med*. January 20, 2004;2(3):1-4. <http://www.translational-medicine.com/content/2/1/3>. Accessed November 18, 2005.

Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the US. *JAMA*. 2011;286(10):1195-1200.

More than Six Authors

McGlynn EA, M.Asch S, Adams J, et al. The quality of health care delivered to adults in the United States. *N Engl J Med*. June 26, 2003;348(26):2635-2645.

Authors Representing a Group

Moher D, Schulz KF, Altman D for the CONSORT Group. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. *JAMA*. 2011;285(15):1987-1991.

Book

Byrne, DW. Publishing your medical research paper: What they don't teach in medical school. Baltimore: Williams & Wilkins, 1998.

World Wide Web

The key and critical objectives of JAMA. <http://jama.ama-assn.org/misc/aboutjama.dtl>. Accessed April 4, 2007.

Tables

1. Cite all tables consecutively in the text and number them accordingly.
2. Create tables preferably using Microsoft Excel with one table per worksheet.
3. Tables should not be saved as image files.
4. The content of tables should include a table number (Arabic) and title in capital letters above the table, and explanatory notes and legend as well as definitions of abbreviations used below.
5. Font consistent with other text, size 8.
6. Each table must be self-explanatory, being a supplement rather than a duplicate of information in the text.
7. Up to a maximum of five (5) tables are allowed.

Figures and Graphs

1. Figures or graphs should be identified by Arabic Numeral/s with titles and explanations underneath.
2. The numbers should correspond to the order in which the figures/graphs occur in the text. It is recommended that figures/graphs also be submitted as image files (preferably as .jpeg or .gif files) of high resolution.
3. Provide a title and brief caption for each figure or graph. Caption should not be longer than 15-20 words.
4. All identifying data of the subject/s or patient/s under study such as name or case number, should be removed.
5. Up to a maximum of five (5) figures and graphs are allowed.

Illustrations and Photographs

1. Where appropriate, all illustrations/photographic images should be at least 800 x 600 dpi and submitted as image files (preferably as .jpeg or .gif files).
2. For photomicrographs, the stain used (e.g., H&E) and magnification (e.g., X400) should be included in the description.
3. Computer-generated illustrations which are not suited for reproduction should be professionally redrawn or printed on good quality laser printers. Photocopies are not acceptable.

1. All letterings for illustration should be done professionally and should be of adequate size to retain even after size reduction.
2. Figure legends should be numbered sequentially, typed double-spaced on a separate sheet of paper. Give the meaning of all symbols and abbreviations used in the figure.
3. Up to a maximum of five (5) illustrations/paragraphs are allowed.

N.B.: For tables, figures, graphs, illustrations and photographs that have been previously published in another journal or book, a note must be placed under the specific item stating that such has been adapted or lifted from the original publication. This should be also referenced in the References portion.

PROCESS

1. Upon receipt of the manuscript, the Editor shall review the submission, check if it has met aforementioned criteria and consult with members of the Editorial Board to decide whether it shall be considered for publication or not.
2. Within one (1) week of submission, authors shall be notified through e-mail that their manuscript either (a) has been sent to referees for peer-review or (b) has been declined without review.
3. The JPDA implements a strict double blind peer review policy. For manuscripts that are reviewed, authors can expect an initial decision within forty five (45) days after submission. There may be instances when decisions can take longer than 45 days, in such cases, the editorial assistant shall inform the authors. The editorial decision for such manuscripts shall be one of the following: (a) acceptance without further revision, or (b) major manuscripts revision and resubmission.
4. Accepted manuscripts are subject to editorial modifications to bring them in conformity with the style of the journal.

EDITORIAL OFFICE CONTACT INFORMATION:

Journal of the Philippine Dental Association
Ayala Avenue corner Kamagong St. San Antonio Village, Makati City
Telephone number: (632) 890-4609, 632) 897-8091
Telefax number: (632) 899-6332
E-mail: thepdajournal@gmail.com

ARTICLE TYPES

Original Articles

The abstract should contain no more than 200 words with a structured format consisting of the objective/s, methodology, results and conclusion. A manuscript for original articles should not exceed 25 typewritten pages (including tables, figures, illustrations and references) or 6000 words.

Reviews

Review articles provide information on the "state of the art." JPDA encourages that reviews not only summarize content understanding of a particular topic but also describe significant gaps in the research, and debates. The abstract should be from 50 to 75 words and should not be structured. A manuscript for reviews should not exceed 15 typewritten pages (including tables, figures, illustrations and references) or 4000 words.

Case Reports

The abstract should be from 50 to 75 words and should not be structured. A manuscript for case reports should not exceed 10 typewritten pages (including tables, figures, illustrations and references) or 3000 words.

Feature Articles

JPDA may feature articles, either as part of an issue theme, such as Summary Clinical Practice Guidelines on dentistry from each specialty society, or a special topic on dentistry by the internal expert or authority. The abstract should be from 50 to 75 words and should not be structured. A manuscript for feature articles should not exceed 25 typewritten pages (including tables, figures, illustrations and references) or 6000 words.

Brief Communications

Brief Communications are short reports intended to either extend or expound on previously published research OR present new

and significant findings which may have a major impact in current practice. If the former, authors must acknowledge and cite the research which they are building upon. The abstract should be from 50 to 75 words and should not be structured. A manuscript for brief communications should not exceed 5 typewritten pages (including tables, figures, illustrations and references) or 1500 words.

Editorials

Articles that reported the scientific opinion and views of an author. Every issue of JPDA includes an Editorial by the Editor-in-Chief and may include one or two additional editorials from experts from scientific community commenting on a particular field or issue on dentistry. No abstract or keywords necessary.

Letter to the Editor

JPDA welcomes feedback and comments on previously published articles in the form of Letter to the Editor. No abstract or keywords necessary. A Letter to the Editor must not exceed 2 typewritten pages or 500 words.

Special Announcements

Special announcements may include upcoming conventions, seminars or conferences relevant to dentistry. The Editors shall deliberate and decide on acceptance and publication of special announcements. Please coordinate with the Editorial Coordinator for any request for special announcements.

Philippine Dental Association
Ayala Avenue corner Kamagong Street, Makati City 1200, Philippines