

Incisaal edge

Specialty Edition

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Student Research Group
University of Texas Health Science
Center at Houston School of Dentistry

In This Issue

ABOUT INCISAL EDGE

Incisal Edge is a student-run, research-focused newsletter from UTHealth School of Dentistry's Student Research Group. A play on "the cutting edge," the title stands for the intersection of dentistry, research, and storytelling.

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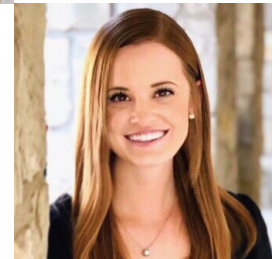
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Want to get involved? *Incisal Edge* is always looking for interested writers! We also want to hear from you!

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When we started planning for the “Specialty Edition,” we penned in only general topics and were excited to let the writers take the driver’s seat. This time the writers truly brought in the best ideas! Read about the how to prescribe antibiotics and a novel approach to endodontic irrigation. Articles like these — a dive into different corners of dentistry and the forefront of dental technology — are what makes the research newsletter special. I can confidently say we have covered the dentistry not taught in lectures.

Let me introduce SRG’s Content Editors! Thanks to their work, we have been able to dedicate more manpower on each article. We accomplished so much more as a team than we would have individually, which is fitting to this issue’s theme.

Finally, I will sign off with a quote from the movie *Ida* (2013).

“They never told you? Your real name is Ida Lebenstein.”

EDITOR-IN-CHIEF

Ryan Lee '23



A Letter From the Editor

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DOC, I need an *occlusal* *guard* ASAP!

HOBIN CHUN
Writer '23



OCCLUSAL GUARDS are a simple and effective treatment to protect a smile. Night or daytime stress can lead to parafunctional habits. Stress can come from dental school or from the ongoing COVID-19 pandemic. However, the demand for occlusal guards can arise from multiple factors ranging from dental issues to other underlying medical conditions.

A costly story

One afternoon, I decided to indulge in a bowl of pistachio ice cream. All of a sudden, I felt my tooth crack into pieces. I was horrified as I felt bits of my enamel coming off the side. After a dentist restored the missing enamel, I visited the A.P. Westfall, DDS Orthodontic Clinic and consulted a resident. They recommended a concurrent treatment of an occlusal guard and Invisalign.

In order to receive an occlusal guard at the UTSD undergraduate clinic, a patient would first need to receive a traditional impression or a digital scan. Afterwards, the patient would have to wait at least two weeks for the laboratory to fabricate the occlusal guard and deliver it to them. This process would cost around \$180, which is priced much more competitively than most private practices. However, I believe there is still room for improvement. Decreasing the total cost and streamlining the process could ultimately make occlusal guards more accessible to more individuals.

The promise of digital

Dr. Ryan Quock and Dr. Maria Gonzalez from the Department of Prosthodontics make the claim for a digital workflow in an article published in *Decisions in Dentistry*. They wrote:

Utilizing in-house 3D printers and Intraoral scanners improves the experience for both the patient and the provider. Digital approaches to restorative procedures can have similar outcomes to traditional analog techniques.

While digital dentistry has many advantages, many doctors are apprehensive about using it due to its novelty. One major hurdle is the perceived overhead of digital dentistry.

What is the cost of entry?

A digital occlusal guard requires five things: a printer, a scanner, a post processor, software, and the material. As with purchasing any type of instrument, the cost can be justified by how frequently it is used. For example, if scanners are used to manufacture crowns and bridges in addition to occlusal guards, an intraoral scanner can create profit rather than financial harm.

Purchasing the printer and the post processor would cost \$8,000. Thus, if you make five occlusal guards per month, the instrument would be paid off within 18 months. However, another expense may come from outsourcing. Designing the occlusal guard can be done in-house through



*“All of a sudden, I felt my tooth crack into pieces. I was **horrified** as I felt bits of my enamel coming off the side.”*

software like Exocad™. Because there may be an initial learning curve in operating this software, many providers may choose to outsource the programming by paying an average of \$25 per month from companies like Evolve™, Ful Contour™, and Outcad™.

Increasing accessibility of occlusal guards through digital dentistry.

Many studies have shown cost is one of the primary barriers that prohibit many Americans to seek dental care. According to the ADA Health Policy Institute, “In 2018, 42% of Americans admitted to not going to the dentist as often as they felt they should, many of whom cited cost as a primary reason.” In my case, I was hesitant to obtain an occlusal guard even though it was urgently needed. If having an in-office printer could significantly reduce laboratory cost and time, this may allow more people to have access to quality dental care. ■

Comparison of digital and analog of fabricating an occlusal guard

	Digital	Analog
Time	2-3 hours	2 weeks + adjusting time (if sent to a lab)
Cons	<ul style="list-style-type: none"> • Initial high instrumentation fee • Mass production, less personalized 	<ul style="list-style-type: none"> • Polymerization shrinkage with acrylic up to 30%, would require additional adjusting time • Quality, personalized
Materials	Virtual software articulator	Pour up, wetlab mount to articulator

Cost of entry of fabricating a occlusal guard digitally

Intraoral scanner	\$30,000 (Trios)
Printer + post processor	\$8,000
Software	\$1,000 per year or \$25 per guard (outsource)
Time to print and process	80 mins
Material	\$3.30 per guard, \$470 per bottle (1000ml)

Source: <https://learndentistry.com/3d-printed-occlusal-guards>

Are we **TREATING** or preventing?

Does it matter when it comes to the use of antibiotics in dentistry?

ANDREW PERRY
Guest writer '24



ANTIBIOTICS are used to prevent a potential infection and to treat an existing infection. However, physicians and dentists must carefully consider when to prescribe them. Antibiotic overuse gives rise to the pressing concern of drug-resistant organisms. Responsible practice begins with understanding the language used to describe prescribing habits. Reflecting on my time as a dental student, I realized the concept of prophylaxis versus therapeutic treatment had been cloudy to me. Using the correct terminology is important, because it helps organize thoughts when choosing the best therapy.

Troublesome terminology

The use of antibiotics to prevent an infection is described as *prophylactic*, much like a “prophy” helps prevent dental decay. Prophylactic antibiotics are indicated when a patient has a medical condition known to be high risk for an infectious complication. The patient should take the antibiotic before they undergo any invasive dental procedure. Stated briefly, there are two criteria in considering the use of prophylactic antibiotics: 1) there must be a patient who is at risk, AND 2) the procedure must

be invasive.

A select group of heart abnormalities are considered elevated risk, because of their potential for developing infective endocarditis. The specific cardiac conditions that require antibiotic coverage are available from the American Heart Association in a 2007 *Circulation* article by Wilson *et al.* Patients with prosthetic joint implants were previously thought to be at greater risk for infection of their hardware from dental procedures. However, recommendations from a 2015 *Journal of the American Dental Association (JADA)* article by Sollecito *et al.* state:

In general, for patients with prosthetic joint implants, prophylactic antibiotics are not recommended prior to dental procedures to prevent prosthetic joint infection.... This clinical recommendation should be integrated with the practitioner’s professional judgment and the patient’s needs and preferences.

The second criterion for prophylactic antibiotics requires that the procedure is considered invasive. The term “invasive,” as it applies to dental procedures, is defined by a 2020 *JADA* article by Thornhill *et al.* to be procedures

that “involve manipulation of gingival tissues or the periapical region of teeth or perforation of the oral mucosa.” A list of the procedures considered to be invasive is available, but the definition mentioned above is the best way to conceptualize and apply the idea of an invasive dental procedure.

The use of antibiotics for an existing oral infection is described as therapeutic. Common oral infections include odontogenic and periodontal abscesses. A surgical procedure is the primary means of managing an oral infection, while antibiotics are an adjunct. A 2019 JADA article by Lockhart *et al.* recommends endodontic treatment or incision and drainage “should be prioritized in all cases,” and antibiotics should “be used only when systemic involvement is present.” Systemic involvement is characterized as “malaise or fever.” A 2017 publication by Martins *et al.* in The Journal of Oral and Maxillofacial Surgery (JOMS) discusses odontogenic infections and the importance of drainage of the infection, and elimination of the cause of infection by either endodontic therapy or extraction. Antibiotics as an adjuvant are recommended when the host defenses are not able to limit the effects of the infection to the area immediately adjacent to the source of the infection. Signs of systemic manifestations of infection are cellulitis, trismus, tachycardia, dysphagia, malaise, or fever.

Therapeutic antibiotic treatment can be subclassified into empiric and definitive therapies. Empiric antibiotic therapy is directed at the microbes that are most likely the cause of the abscess. Definitive antibiotic therapy is directed at a known microbial cause. The only way to know the identity of the causative organism is to take a sample of the purulent material and grow it in a lab (which may take a few days to culture). The 2017 JOMS article states a penicillin class antibiotic is the first-choice drug and is started at the time of incision

“Responsible practice begins with understanding the language used to describe prescribing habits.”

and drainage if systemic manifestations are present.

Resistance and reactions

The motivation for the mindful use of antibiotics is to reduce the effects on antibiotic resistant organisms and adverse drug reactions. Antibiotic resistance refers to a group of microorganisms that, after repeated exposure, no longer respond to an antibiotic. This may cause harm by reducing the effect of antibiotics in the treatment of sepsis, prevention of surgical site infections, and treatment of infection in organ transplant patients, patients receiving dialysis, and patients receiving chemotherapy. Adverse drug reactions can be as mild as a skin reaction, or as severe as anaphylaxis.

Responsible prescribing habits start with the selection of the appropriate clinical case. Picking the correct class, dosage, frequency, and duration all depend on your indication: prophylactic or therapeutic. The 2017 JOMS article states the risk for antibiotic resistance increases with the duration of therapy. When prescribing antibiotics as prophylaxis, the duration is a single dose prior to the procedure. When used for therapeutic treatment, the duration is 2-3 days after drainage of the abscess. Even a seemingly small reduction in the duration or a reduction in the dosage of an antibiotic can slow the development of antibiotic resistant organisms. Using the shortest effective duration of antibiotic therapies when treating oral infections makes us better providers. Establishing thoughtful antibiotic prescribing habits will help maintain the effectiveness of our drug therapies and reduce the rate of creating resistant organisms. ■

OVERALL HEALTH

Welcome to our guest column, where we feature an article written by a student from McGovern Medical School. Following UTSD’s vision, the guest writer takes on a topic that connects oral and overall health. The goal of this column is to make the connection ever more salient here in the Texas Medical Center.

Andrew Perry, DDS is a current third-year resident in the Oral and Maxillofacial Surgery program at the UT School of Dentistry with concurrent enrollment in UT School of Medicine. He completed his dental education at the LSU School of Dentistry in New Orleans, LA in 2018. His academic interests include management of medically complex patients and pediatric dentoalveolar trauma. He is expected to complete his residency training in 2024.

The connection between periodontal research and **THE STUDENT RESEARCHER**

LAURA ARSTO
Secretary '23



EVIDENCE-BASED DENTISTRY is at the heart of modern education. It drives the changes we make in in everyday clinical practice, but we should also understand where evidence comes from. Take periodontal research for example. Dr. Bing-Yan Wang, DDS, MS, PhD, DMSc, is a professor in the Periodontics and Dental Hygiene Department. She said, “I have always considered research an essential component of dental education. The dental field has seen tremendous progress because of the collective efforts of researchers. The research aspect of dentistry is also important for students, because students represent the future of our field.”

A career in periodontology

Dr. Wang became interested in periodontology after her DMSc in immunology and research in that area. “One of the deciding factors for me to choose periodontology was that periodontists do extensive research and emphasize evidence-based practice,” she said. “It occurred to me that periodontology and immunology have many similarities in research areas, and my immunology background could help me accomplish more in my professional field.”

Dr. Wang shared some advice for other research-minded students. “Keep in mind that research activity can help you accomplish more in your professional career. Choose a project that you like and can be completed

within your busy schedule at UTSD. Ask advice from other students and your supervising faculty. Work hard.”

The importance of periodontal research

“Periodontitis is one of the most widespread infectious diseases in adulthood, with an estimated 46% of US dentate adults age 30 years and older suffering from some form of the disease,” Dr. Wang said. Dentists rely on dental research for proper prevention, diagnosis, and treatment.

Clinical link example: A racial disparity

The National Health and Nutritional Examination Survey (NHANES) reported disparities in periodontitis prevalence among different races and ethnic groups. They found that African Americans and Hispanics are groups more likely to have the disease.

The study highlights the connection between evidence and clinical application. Knowing who the disease affects most makes us more informed clinicians.

“*Porphyromonas gingivalis* is a periodontal pathogen capable of inducing periodontitis. **Even in low abundance**, its presence in the oral cavity disturbs host-microbial homeostasis.”

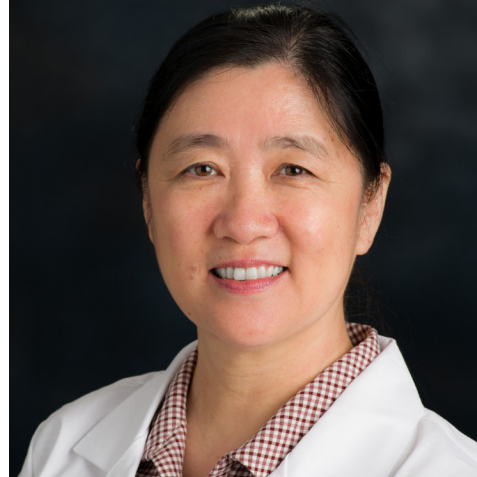
A deeper dive: Pathogenicity of *P. gingivalis*

Porphyromonas gingivalis is a periodontal pathogen capable of inducing periodontitis. Even in low abundance, its presence in the oral cavity disturbs host-microbial homeostasis.

Pathogenicity begins with bacterial adherence in the oral cavity. *P. gingivalis* uses multiple cellular and extracellular components such as fimbriae, proteases, and hemagglutinins for adherence. FimA is a major subunit of such long fimbriae, and its absence prevents the formation of *P. gingivalis* biofilms. The Wang lab found that another organism *Streptococcus cristatus* mediates this mechanism to block *P. gingivalis* growth. *S. cristatus* releases arginine deiminase which represses fimA expression. In a mouse model, *S. cristatus* also interferes with alveolar bone loss. Finally, dental plaques in the mouse model contain high levels of *P. gingivalis*, and low levels of *S. cristatus*.

The Wang lab wants to find the distribution of *P. gingivalis* and *S. cristatus* in periodontitis sites in the oral cavity. She also wants to assess risk factors of the hosts that may affect their disease.

The pathogenesis of periodontitis is one of the key aspects of research for understanding this disease. When we know how it develops and the predisposing factors, we can better treat our patients and intervene early. ■



Dr. Bing-Yan Wang, DDS, MS, PhD, DMSc, is a professor in the Periodontics and Dental Hygiene Department.

TOOTH AGENESIS

research from a clinician-scientist perspective

ELIZABETH HUNTER
Writer '24



DR. ARIADNE LETRA, DDS, MS, PhD, is a professor in the Department of Diagnostic and Biomedical Sciences and interim associate dean for research at UTHealth School of Dentistry. She started her career in Brazil earning her DDS, certificate and MS in Endodontics, and a PhD in Oral Biology. Before coming to UTSD, she finished a postdoctoral fellowship and became an assistant professor at the University of Pittsburgh School of Dental Medicine.

How did you originally get involved in academic research?

“I got involved in research during my certificate program in endodontics in Brazil which was led by worldwide recognized leaders in the field. I soon realized that I really enjoyed research, in addition to clinical work, and that led me to pursue a Master of Science in endodontics. I wanted to understand more about the biological mechanisms leading to the infection and pain that my patients were experiencing. At that time, I was certain an academic career was the right choice for me and enrolled in a PhD program in Oral Biology at the University of Sao Paulo. My molecular biology pursuits intersected with my curiosity on human genetics diseases and disorders and that is how I became involved with cleft lip and palate and tooth agenesis research. The University of Sao Paulo houses the largest Hospital for Rehabilitation of Craniofacial Anomalies in South America, with over 100,000 patients, majority of which have cleft lip and palate. My research focus on gene discovery of cleft lip and palate and dental anomalies led me to win a national scholarship to pursue a post-doctoral fellowship at the Center for Craniofacial Genetics at the University of Pittsburgh, where I stayed until moving to Houston to join UTSD and the Center for

Craniofacial Research.

What research are you currently working on?

“My lab focuses on understanding human genetic variation contributing to craniofacial anomalies and also oral inflammatory conditions such as apical periodontitis. We continuously recruit patients with these conditions, as well as healthy individuals as controls, for our gene discovery studies. Another aspect of our research focuses on finding common genetic variations potentially linking poor oral health with adverse systemic health outcomes.”

Research spotlight: Tooth agenesis

“Tooth agenesis has an etiology that is mostly genetic and highly variable. In fact, not a single gene has been attributed as etiologic. There is a lot of genetic heterogeneity and variability in the clinical presentations of tooth agenesis between patients and their family members which complicates the identification of etiologic genes.

“We believe the impact of our research is two-fold. First, in cases of familial tooth agenesis, identification of causative genes is facilitated by sequencing multiple family members and comparing their DNA sequences to identify where the genetic variant is inherited from. In these cases, we are able to deliver the results of genetic findings to the family, and this may provide important information to be used in genetic counseling for improved recurrence risk estimates within families.

“Second and a more distant goal, we hope the genes identified through our research could be used as targets for future research on patient-centered tooth regenerative therapies.”

At what stage is your research on tooth agenesis in?

“We are still in the gene discovery stages. Our lab has pioneered the use of next generation sequencing in patients with tooth agenesis, and we have reported new genes as potentially etiologic. Our work has also shown that more than one defective gene may play a role in tooth agenesis in a few families. Once we identify the potentially causal genetic variation, we take advantage of *in vitro* and *in vivo* model systems to better understand the effect of the genetic defect on protein function and how that could result in tooth agenesis.”

What role does the dentist play in a patient with tooth agenesis?

“Although tooth agenesis is common, it is often overlooked as a significant birth defect with functional, esthetic, and psychological consequences. Often times, even patients and their families discard the importance of finding out the reason why they were born without one or more permanent teeth. As dentists, we are responsible for the oral health of our patients; that includes diagnosing dental anomalies such as tooth agenesis and educating our patients about the reasons why these occur. For those individuals and families that wish to know more, referral to a genetic counselor or genetic testing is also recommended.

“Tooth agenesis has an etiology that is mostly genetic and highly variable. In fact, not a single gene has been attributed as etiologic.”

Maria Messing, DDS, MSD (won JOE award) with work entitled ‘Investigating Potential Correlations between Endodontic Pathology and Cardiovascular Diseases Using Epidemiological and Genetic Approaches’



Meredith Williams, DDS, MSD (won Hatton award) with work entitled ‘Association between colorectal cancer polymorphic variants and isolated tooth agenesis’

How does research intersect with clinical practice?

“In my view, clinical practice and research are interrelated. As a clinician, I am always looking for the best scientific evidence to translate into evidence-based clinical care of my patients. As a scientist, my goal is to find the key biological players involved in oral diseases that may inform clinical practice. For example, finding critical genes and proteins involved in a particular disease may lead to the development of more effective, targeted treatments.

“Overall, either being directly involved in research or reading scientific research publications makes me be a better clinician. It prompts me to better understand the mechanisms of oral diseases and how oral and overall health can have an impact on each other. It improves my diagnostic ability, treatment plans, and assessment of treatment outcomes in a holistic perspective considering the patient as a whole.

“In an academic setting, we are generally viewed by the population as a source of reliable scientific information for the conditions and diseases that we treat. And so I take that as my obligation to seek and provide the most up to date scientific information to my students, colleagues, and patients. Most of the research breakthroughs leading to improved patient care, whether in dentistry or medicine, come from academic institutions in which clinicians and scientists engage in collaborative efforts towards discoveries to improve patients’ lives.” ■

Student spotlight: **Mary Younan**

JACKSON VALENCIA
Writer '23



MARY YOUNAN is a member of the UTSD class of 2023 and the winner of the 2020 UTSD Student Research Showcase. Her work, “Prolonged General Anesthesia in a Pediatric Population,” was conducted under the mentorship of Dr. Brett Chiquet, DDS, PhD. Dr. Chiquet is an associate professor in the Department of Pediatric Dentistry.

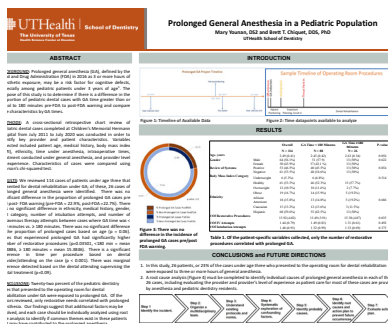
Where did the idea for this research come from?

Dr. Chiquet met “James,” a three-year-old boy with a history of epilepsy, seizures, and autism. James had undergone dental treatment by UTHealth pediatric dental residents to receive six crowns and three pulpotomies in an operating room setting under general anesthesia. After a few weeks of follow up, everything looked good. Incidentally, James swallowed one of his crowns, so he and his mother came into the clinic. During the visit, she complained of a deterioration in James’ motor coordination and ability to function cooperatively in the home environment following dental surgery. She requested data from the operating room for review by James’ neurologist.

In 2016, the FDA warned against prolonged general anesthesia of three or more hours in children under three years of age. In 2017, the FDA updated and reinforced that warning. As the surgical data revealed, James’ sedation exceeded the three hour limit. His regression shows the results of prolonged general anesthesia and the motivation for the FDA warnings.

Younan said, “I wanted to know if we had made progress as an institution after the 2017 FDA warning. My research question was: ‘Does a difference in the proportion of prolonged general anesthesia cases exist before and after the updated FDA warning?’”

“Does a difference in the proportion of prolonged general anesthesia cases exist before and after the updated FDA warning?”



Younan’s poster is titled “Prolonged General Anesthesia in a Pediatric Population”.



Mary Younan is a current DS2 and winner of the 2020 Student Research Showcase

What did you find?

“Most of these operating room procedures at UTHealth are done by pediatric dental residents. Just like dental students, residents are a bit slower in procedures, because they are still training. Longer procedure durations can translate to longer general anesthesia, which is what we are trying to avoid.

“Before the 2017 FDA warning, 21.9% of our general anesthesia cases were longer than three hours. After the updated warning, 22.7% of cases were longer than three hours. Unfortunately, this was evidence that we, as an institution, got worse at keeping the general anesthesia under the suggested timing regulations. As frustrating as this information was, it also was extremely eye-opening. It led us to wonder: “What are the steps we can take to implement change?”

“We performed a root cause analysis, i.e. a thematic analysis, to identify contributing factors to prolonged general anesthesia in operating room pediatric dentistry. We found four:

1. Complexity of planned dental work
2. Medical complications during surgery
3. Additional services during dental rehabilitation
4. Lower training level of the provider

What does the result mean?

“Keep in mind this research was based on data from dental procedures done in an academic setting, so we cannot apply our conclusions outside this institution or to private practice. At present I am brainstorming ideas on how the Pediatric Dentistry Department can educate faculty and students about this because I believe

awareness is a key step in prevention.

“Another idea is to position pediatric dental cases requiring general anesthesia later in the training of residents so that they are more prepared before they begin these challenging cases. Here are three systems we want to create:

1. An operating room checklist to help prevent negative events with general anesthesia
2. A resident training program addressing patient safety
3. A post-operative quiz for the attending faculty to identify times when surgery reached the three-hour mark, and any difficulties with the surgery.”

What was it like to conduct your research remotely, and to present at the first-ever virtual Student Research Showcase?

“Regarding the Student Research Showcase, I think we did not get quite the same audience in each room as we would have had in person. Normally, it is fun to have each room full and to go watch other presenters. With the virtual format, I had to stay in the same room, so I was not able to switch between rooms to watch other presentations.

“Dr. Chiquet and I worked virtually, without meeting in person for the entire summer! It was awesome to see we were capable of conducting research in a remote format. I think we would not have realized remote research could be successful without COVID to force us to try our proverbial hand at it.” ■

GentleWave — AN INNOVATIVE ROUTE TO THE ROOTS



JANE LEE
Writer '23



SUCCESSFUL ENDODONTIC THERAPY depends on the complete debridement of pulp tissue. It remains the most fundamental yet difficult to achieve aspect of the procedure. Even though root canal therapy is a common procedure, Siqueira *et al.* in the 2019 International Endodontic Journal showed that approximately 10-50% of root canal systems remain untouched by files and irrigants. For as long as nonsurgical endodontic therapy has existed, this has been the drive behind countless research papers.

I had the chance to discuss a fascinating approach to root canal treatment with Dr. David Jaramillo, DDS, professor in the Department of Endodontics. As soon as I walked into his office, I noticed a large device, called GentleWave, which was the main subject of my intriguing conversation with him.

Dr. Jaramillo described GentleWave as a high technology console from Sonenda®. “It is a multi-sonication device that generates a phenomenon in the pulp chamber and root canal which helps with the debridement and removal of debris located anywhere in the root canal system, including those areas that are difficult to reach,” he said.

A novel approach

Current literature is filled with tweaks to the traditional workflow of mechanical debridement, chemical irrigation, and obturation. For example, TruShape 3D Conforming Files by Dentsply Sirona and XP-3D Shaper by Brasseler modify the shape of rotary files. Although they were uniquely designed to increase the success of cleaning and shaping while maintaining root canal shape, neither showed improvements in all parameters studied, according to Morales *et al.* in the 2020 Journal of Endodontics.

GentleWave takes on a completely different approach to cleaning the root canal system. Dr. Jaramillo gave a run-through of the GentleWave Procedure:

1. After the access cavity is made, the canal is minimally enlarged up to a #20 file with 0.04 mm taper.
2. Unique to GentleWave, a platform is built to help seat and adapt the single-use console handpiece called the Procedure Instrument, forming a seal. The tip of the handpiece is placed 1 mm above the pulp chamber floor.
3. The Procedure Instrument delivers a solution made of 3% NaOCl, 8% EDTA, and water that has been optimized by the console at a pressure of 9000 PSI. The system runs for 7 minutes, delivering 5 min of NaOCl, 1.5 min of EDTA, and 30 seconds of water to deliver a total of 450 mL of the procedure fluid.

Sigurdsson *et al.* in 2018 Journal of Endodontics wrote, “[Fluid] enters the root canal system, creating a powerful shear force...[that] causes hydrodynamic cavitation.” Microbubbles inside this cavitation flow throughout the fluid.

ABOUT DR. DAVID JARAMILLO, DDS

Dr. Jaramillo's interest in endodontics stemmed from attending lectures by Dr. Alfred Frank, who found the pulpotomy protocol that is still being used today, and through mentorship from endodontic faculty when he was a dental student. He recalls being interested in the numerous histology that was used to test the biocompatibility of dental materials — a line of research that is still in the works today.

“It is a multi-sonication device that generates a phenomenon in the pulp chamber and root canal which helps with the debridement and removal of debris located anywhere in the root canal system...”

“This is where the multi-sonication waves are being created and travel throughout the root canal,” said Dr. Jaramillo. “At the same time, there is negative pressure that evacuates the solution containing debris.”

He shared some papers that show cross sections at the apical and middle region of MB and ML canals of mandibular molars and MB canals of maxillary molars. In all sections, the GentleWave procedure significantly improved cleaning efficacy when compared with conventional methods. Molina *et al.* in the 2015 Journal of Endodontics showed GentleWave was capable of cleaning 97.2% and 98.1% of mandibular molars and maxillary molars, respectively, compared to 67.8% and 87.3% seen with conventional instrumentation. Furthermore, Dr. Jaramillo's own studies on extracted lower third molars show that obturation is possible even with minimal canal enlargement.

Dr. Jaramillo plans on further studying the efficacy of the GentleWave Procedure via *in vivo* studies with patients at UTSD.

Reflection

As a second-year dental student learning the basic principles of root canal therapy, I was impressed by the fundamentally different approach to cleaning root canals. I appreciate how dentistry is continuously evolving. As the engineer Henry Petroski said, “Successful design is not the achievement of perfection but the minimization and accommodation of imperfection.” With the technology available today, it is becoming ever more important to consider paradigm shifts in certain procedures in order to achieve the best clinical outcome. ■

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