UBC DENTISTRY

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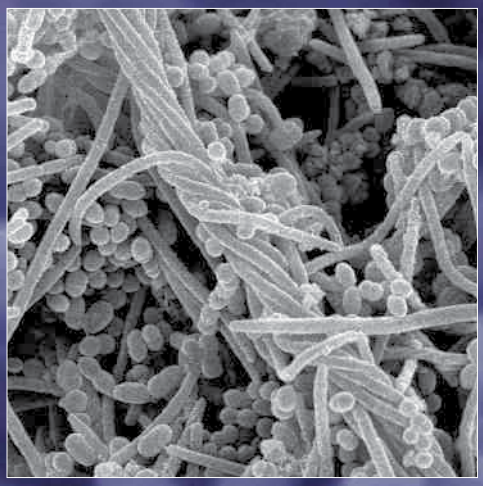
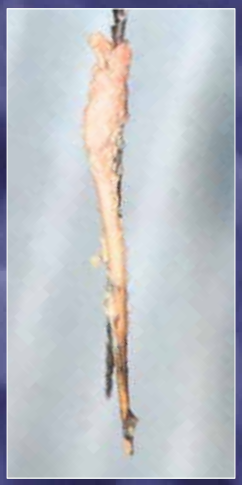


Biofilm Disease Dynamics: From Understanding to Eradication

JANUARY 24, 2012



RESEARCH DAY 2012

Advancing oral health through outstanding education, research, and community service.

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Cover images courtesy of Mark Parhar and Zhejun Wang.

MESSAGE FROM THE DEAN

Welcome to the Fifth UBC Faculty of Dentistry Research Day.

We have been very happy with the extremely positive responses to the previous four Research Days. The 2012 Research Day continues the approach of using a clinical case to introduce the need to conduct basic research and the translation of research findings into patient care applications. Research remains a critical Strategic Goal for our Faculty of Dentistry and we hope that this day highlights the links between basic research and clinical dentistry.

The overall theme for this Research Day is microbial biofilms. The organization of bacteria into communities called biofilms has led to many new advances in understanding and treating oral diseases. The most frequent dental diseases are all biofilm-related and thus it is critical to understand the fundamental properties of microbial biofilms in order to develop the appropriate treatment plan and long-term strategy for disease prevention. In the past, strategies for treating and preventing bacterially-related diseases were based on analyses of bacteria in the planktonic stage. However, it has become clear that very different strategies are required to reduce the disease-causing potential of bacteria in a biofilm. We are fortunate that UBC is at the cutting edge of this type of research leading to new approaches to patient care.

We are delighted to have a keynote speaker who is recognized as the "Father of Microbial Biofilms," Professor William Costerton, who is also a native of British Columbia. It was my pleasure to collaborate with Dr. Costerton while we were both on the faculty at the University of Southern California and he played an instrumental role in our work on microbial biofilms in osteonecrosis. He will provide an outstanding review of the role that biofilms play in disease.

I hope you enjoy the program and gain additional insight into the research that has supported advances in new treatments for diseases caused by microbial biofilms and new strategies to prevent diseases by managing biofilms. Future research advances in the field are certain to make a difference in the incidence and prevalence of oral disease.

Thank you for your participation.

Charles F. Shuler, DMD, PhD
Professor and Dean, UBC Faculty of Dentistry

ENDODONTICS CASE

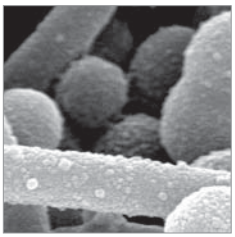
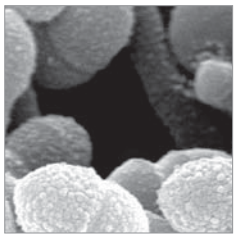
This patient was referred from private practice to the UBC Graduate Endodontics Clinic to assess tooth 41. The referring dentist, upon inspection of the radiograph, noted a resorptive lesion on the root of 41. After further examination, the patient was sent for a cone beam computed tomography scan to obtain a three-dimensional image of the defect. The 3D image verified the resorptive lesion on 41 but also identified a large periapical radiolucency associated with tooth 34. Tooth 34 had been root canal treated approximately 2 years earlier and was asymptomatic. The patient was examined and a sinus tract associated with tooth 34 was noted. Non-surgical root canal re-treatment for 34 was recommended due to the persisting infection. The patient agreed to a treatment plan and was seen over two appointments to complete the treatment.

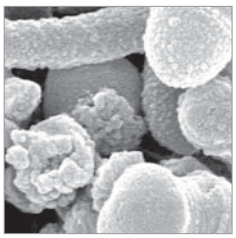
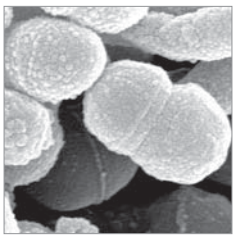
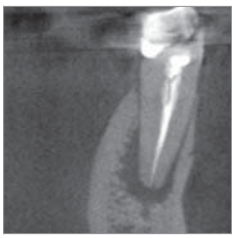
[Case courtesy of Dr. Mark Parhar]

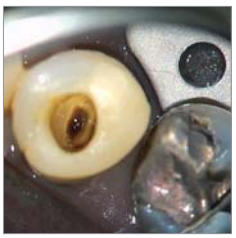
Case Learning Objectives

At the end of the day, participants are expected to be able to:

- Comprehend the goals of endodontic treatment;
- Identify the differences between planktonic bacteria and biofilm;
- Explain why bacteria in a biofilm are difficult to eradicate;
- Describe new strategies to attack biofilms;
- Understand the differences between the various chemical and physical methods of killing biofilm bacteria;
- Appreciate the links between general health, medication, and oral infections;
- Discuss various methods and strategies to control a common biofilm disease—dental caries—at the population level; and
- Anticipate the mechanisms of resistance by biofilm bacteria to antibiotics, disinfectants, and mechanical removal efforts.



UBC Dentistry Research Day 2012
Biofilm Disease Dynamics: From Understanding to Eradication

Tuesday, January 24, 2012 · 8:00 am – 3:00 pm
UBC Student Union Building Ballroom

8:00 – 8:40	**REGISTRATION & CONTINENTAL BREAKFAST**
8:40 – 8:50	**WELCOME** **Dr. Charles Shuler,** Professor and Dean **INTRODUCTION & OVERVIEW OF THE DAY** **Dr. Edward Putnins,** Professor and Associate Dean of Research, Graduate & Postgraduate Studies
8:50 – 9:15	**REVIEW OF THE LITERATURE ON ENDODONTIC FAILURES** **Dr. Jeffrey Coil,** Assistant Professor, Division of Endodontics, Department of Oral Biological & Medical Sciences "What are the factors affecting root canal successes and failures?"
9:20 – 9:45	**APICAL PERIODONTITIS: A BIOFILM DISEASE** **Dr. Markus Haapasalo,** Professor and Chair, Division of Endodontics; Head, Department of Oral Biological & Medical Sciences "What novel microbial biofilm eradication methods are available?"
9:50 – 10:15	**BIOFILM DEVELOPMENT AND MATURATION** **Dr. Ya Shen,** Clinical Assistant Professor, Division of Endodontics, Department of Oral Biological & Medical Sciences "Why are sessile microorganisms in biofilms more resistant to disinfecting agents than planktonic microorganisms?"
10:15 – 10:35	**COFFEE BREAK**
10:40 – 10:55	**POTENTIAL OF PHOTODYNAMICS IN ENDODONTICS** **Dr. Sonja Stojicic,** PhD Student, Division of Endodontics, Department of Oral Biological & Medical Sciences "How can a synergistic use of disinfecting agents enhance photodynamic therapy?"
11:00 – 11:25	**THE ROLE OF MICROBIAL BIOFILMS IN BISPHOSPHONATE-RELATED OSTEONECROSIS OF THE JAWS (BRONJ)** **Dr. Charles Shuler,** Professor, Division of Oral Medicine, Oral Diagnosis & Oral Pathology, Department of Oral Biological & Medical Sciences "Can control of biofilms reduce the incidence of BRONJ?"
11:30 – 11:45	**RESEARCH POSTER AWARDS PRESENTATION** **Dr. Ravindra Shah,** Associate Professor and Director, International Relations Presenting undergraduate and graduate student poster awards.
11:45 – 12:55	**LUNCH (BOX LUNCH PROVIDED) & RESEARCH POSTER VIEWING** Posters by undergraduate students, graduate students, post-doctoral fellows, research associates, visiting scientists, and faculty members.
1:00 – 1:25	**DENTAL CARIES: A BIOFILM DISEASE AND THE COMMUNITY** **Dr. Rosamund Harrison,** Professor and Chair, Division of Pediatric Dentistry, Department of Oral Health Sciences "What methods can we use to help control dental caries in at-risk communities?"
1:30 – 2:45	**BIOFILMS: ON THE CUTTING EDGE (KEYNOTE ADDRESS)** **Dr. William Costerton,** Center for Genomic Sciences, Pittsburgh, Pennsylvania "What strategies do biofilm-associated microorganisms utilize to enhance their resistance to antibiotic and human host defenses?"
2:45 – 3:00	**PATIENT OUTCOME & CASE WRAP-UP** **Dr. Mark Parhar,** MSc/Diploma in Endodontics Student, Division of Endodontics, Department of Oral Biological & Medical Sciences

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MESSAGE FROM THE ASSOCIATE DEAN OF RESEARCH

Thank you for attending the Fifth Annual UBC Dentistry Research Day.

The two most common oral conditions treated by dental professionals—dental caries and periodontal diseases—arise due to the interaction of the host with microbial biofilms. The microbial communities residing in an organic matrix are adherent and more resistant to traditional disinfection methodologies that effectively eradicate planktonic microorganisms. Research Day 2012 is initially focused on another important biofilm-associated disease: apical periodontitis. Endodontic failure in our clinical case demonstrates the clinical significance of failing to effectively eradicate root canal biofilms.

To begin the day, we will have several presentations from the Division of Endodontics. These presentations will start with a clinical focus on endodontic failures and then expand to include presentations on biofilm dynamics, biofilm development, and novel approaches that are being established to control and eradicate resistant biofilms. As the day progresses, the topic of biofilms will be expanded to include their significance in bisphosphonate-related osteonecrosis of the jaws and approaches that are being tested to control dental caries in the community. We are delighted to involve Dr. Bill Costerton, who will present the keynote address on his world-class biofilm research. It is an honour to have him on the speaker agenda for the day and I trust that all will find his presentation to be very insightful. The day will end with a summary on how our clinical case was re-treated in the Graduate Endodontics Clinic and the healing that has been achieved to date.

In closing, I would like to express our appreciation to all who have agreed to participate in Research Day 2012: the outstanding faculty, graduate students, invited guest presenter, and our supporters. Please do read through the rest of this Research Day program booklet to see the other exciting research that is being done by our faculty and students at the University of British Columbia. This book and day is made possible by the hard work of many people on the Research Day Organizing Committee. With that in mind, I would like to personally thank Clare Davies, Ingrid Ellis, Markus Haapasalo, Alison Kovacs, Jane Merling, Nik Williams-Walshe, and Terry Wintonyk, who have all worked very hard to make this day a success.

Do enjoy Research Day 2012.

Edward E. Putnins, DMD, PhD, Dip Perio
Professor and Associate Dean of Research, Graduate & Postgraduate Studies

PRESENTERS
BIOGRAPHIES AND SYNOPSES

JEFFREY COIL
MARKUS HAAPASALO
YA SHEN
SONJA STOJICIC
CHARLES SHULER
ROSAMUND HARRISON
WILLIAM COSTERTON
MARK PARHAR

JEFFREY M. COIL, DMD, MSD, PhD, FRCD(C), FADI, FACD

Dr. Jeff Coil received his undergraduate, dental, and doctorate degrees from the University of British Columbia. He practiced general dentistry for 8 years and was a Clinical Instructor in Endodontics and Periodontics before obtaining his certificate in Endodontics at the University of Washington in 1993. Dr. Coil serves as an editorial consultant for the "Journal of the Canadian Dental Association" and is on the Scientific Advisory Board of the "Journal of Endodontics." He is a Past President of the Canadian Academy of Endodontics and is a Member of the British Columbia Society of Endodontists and the American Association of Endodontists. Dr. Coil is the Mentor for the Northwest Endodontic Study Club and Seminar, a Diplomate of the American Board of Endodontics, and is currently the Director of the Graduate Endodontics Program at UBC.

REVIEW OF THE LITERATURE ON ENDODONTIC FAILURES

The goal of endodontic treatment is to treat and prevent apical periodontitis. If apical pathosis persists after conventional root canal treatment, then endodontic re-treatment and/or surgery are further management options. There are misperceptions on what the true successes of endodontic therapies are and how they should be achieved. Contributing to this confusion is the lack of knowledge on root canal anatomy and the outcomes that good endodontic treatment can bring. This presentation will examine the literature on the failure of endodontic treatment and describe the elements of successful endodontics.

MARKUS P. HAAPASALO, DDS, PhD, FRCDC

Professor Haapasalo is Chair of the Division of Endodontics and Head of the Department of Oral Biological & Medical Sciences. He is Editor-in-Chief of "Endodontic Topics," a former Associate Editor of the "Journal of Endodontics," an Editorial Board Member of the "International Endodontic Journal," and the Editor of "Visual Endodontics 2012" multimedia. His areas of special interest include biofilms, irrigation, persistent infections, and resorptions. Dr. Haapasalo has received several teaching awards including the Louis I. Grossman International Award by the French Endodontic Society in 2007. He is actively lecturing about endodontics worldwide.

APICAL PERIODONTITIS: A BIOFILM DISEASE

The realization that endodontic infections are biofilm diseases has assisted us in dealing with these infections in several ways: it helps us to understand the difficulty in eradicating all of the microbes in the root canal system; it motivates us to aim for maximum effectiveness in root canal disinfection; and it encourages us to develop new chemical and physical methods to attack the infection—the root canal biofilm. This presentation reviews the anatomical and biological challenges in endodontic disinfection and the ground-breaking research occurring at the UBC Faculty of Dentistry on root canal irrigation hydrodynamics, development of novel *in vitro* biofilm models mimicking the *in vivo* biofilm, and the synergistic approaches to biofilm eradication—from thought process to products for clinical use.

YA SHEN, PhD

Dr. Ya Shen received her dental degree in 1993 and her PhD degree in 2004. Since 2008, she has been a Clinical Assistant Professor in the Department of Oral Biological & Medical Sciences at UBC. Dr. Shen has published more than 40 papers in peer-reviewed journals. She is also a reviewer for several international journals. Dr. Shen's main research interests are nickel–titanium instrument fracture mechanics, biofilms, dental materials, and three-dimensional imaging in endodontics.

BIOFILM DEVELOPMENT AND MATURATION

Most of the studies on biofilm formation in the endodontic literature have been conducted by allowing cells to grow and divide under a continuous or frequent supply of fresh nutrients. However, in long-standing cases of apical periodontitis and when endodontic treatment has started, access to nutrients by the microbes is likely to be limited. Many microorganisms can survive such challenging environments by inducing a starvation response. It is quite possible that the adoption of a non-growing state is an important mechanism for survival in the nutrient-deprived environments of the root canal. Knowledge of the structure and physiological state of multi-species biofilms is important in order to understand their special characteristics as well as to monitor the anti-biofilm efficacy of various procedures and chemicals.

SONJA STOJICIC, DDS, MSD

Dr. Sonja Stojicic received her DDS, Master's degree, and Diploma in Endodontics from the Faculty of Dentistry at the University of Belgrade in Serbia. Since 2009, she has been working on her PhD degree at the UBC Faculty of Dentistry. Dr. Stojicic has received a UBC Dentistry Research Day Award in 2010, a UBC Dentistry Joseph Tonzetich Fellowship, a UBC Graduate Studies Four-Year Fellowship, and a Pacific Century Graduate Scholarship. She has published 9 papers in peer-reviewed journals and presented her research at 18 international conferences and meetings. Dr. Stojicic's main research interests are biofilms, irrigants, and lasers.

POTENTIAL OF PHOTODYNAMICS IN ENDODONTICS

Conventional photo-activated disinfection (PAD) utilizes two non-toxic components—a photosensitive agent and a low power laser—in order to destroy bacteria. After entering a bacterial cell, the photosensitizer is activated by laser light, creating a cascade of reactions in which singlet oxygen and free radicals have an important role in causing cell implosion, organelle destruction, and even DNA damage eventually leading to cell death. While most other substances or methods used in root canal disinfection are directly (hypochlorite) or potentially (antibiotics) harmful to the host, it has been claimed that PAD specifically targets microorganisms with no collateral damage. This presentation will focus on the efficacy of conventional PAD in killing *Enterococcus faecalis* and mixed plaque bacteria in suspensions and biofilms, as well as the potential for improvement.

CHARLES F. SHULER, DMD, PhD

Dr. Shuler is currently Dean of the UBC Faculty of Dentistry. Previously he served as Director of the Center for Craniofacial Molecular Biology, Director of the Graduate Program in Craniofacial Biology, Associate Dean for Student and Academic Affairs, and George and Mary Lou Boone Professor of Craniofacial Molecular Biology at the University of Southern California. Dr. Shuler has evaluated and treated patients referred with bisphosphonate-related osteonecrosis of the jaws (BRONJ). Those patient referrals led to the initiation of research on the incidence of BRONJ in patients taking oral bisphosphonates and the role of microbial biofilms in BRONJ, resulting in the development of a clinical protocol to prevent BRONJ.

THE ROLE OF MICROBIAL BIOFILMS IN BISPHOSPHONATE-RELATED OSTEONECROSIS OF THE JAWS (BRONJ)

The prevalence of oral bisphosphonate use by dental patients is rapidly increasing. A side-effect of bisphosphonate use is the development of osteonecrosis of the jaws following trauma to oral tissues. Examinations of bone fragments from BRONJ have identified microbial biofilm formation. The pattern of BRONJ development suggests that the biofilm ultimately causes the osteonecrosis. Dental procedures using techniques to limit the formation of microbial biofilms, such as implant placement, have shown a reduced incidence of BRONJ. Prevention strategies have been proposed and implemented to reduce BRONJ in patients taking oral bisphosphonates. Observations of cases, causes of the osteonecrosis, and approaches to prevent this side-effect will be discussed.

ROSAMUND L. HARRISON, DMD, MS, MRCD(C)

Dr. Rosamund Harrison is Professor and Chair of the Division of Pediatric Dentistry. She embarked on research to enhance dental health in children after extracting one too many teeth from children in diapers. Since then, Dr. Harrison has been an investigator on grant-funded child oral health projects collaborating with communities, dental public health staff, psychologists, and nutritionists. For this work, she received the Canadian Dental Association Oral Health Promotion Award (2004), Honorary Membership in the British Columbia Dental Association (BCDA) (2006), and a BCDA Service Award (2008).

DENTAL CARIES: A BIOFILM DISEASE AND THE COMMUNITY

Is it realistic to expect that traditional preventive dentistry will actually prevent, eradicate, or eliminate dental caries in those with an increased prevalence of severe dental decay? In fact, most of our current preventive interventions only control the process of dental caries such that eventual cavitation of the tooth surface may hopefully be prevented. Furthermore, our contemporary awareness of how family, community, and society influence the dental health of children means that interventions specific to the biofilm or the tooth surface will indeed fall short. These current understandings of the caries process and caries risk have influenced the design of dental health promotion strategies for vulnerable communities. This presentation will focus on recent projects to improve the dental health of children from such at-risk communities.

J. WILLIAM COSTERTON, PhD

Dr. Bill Costerton was born and raised in Vernon, B.C. and attended UBC for his first two degrees in Bacteriology and Immunology. He went on to obtain his PhD from the University of Western Ontario, and completed a post-doctoral fellowship at Cambridge (UK) after serving for 4 years in India as a "scientific missionary." Dr. Costerton's first academic position was at the Macdonald College of McGill University; he then moved to the University of Calgary, where he developed the "biofilm hypothesis" in the 1970s. He has since led major biofilm research groups at the Center for Biofilm Engineering (Montana State), the School of Dentistry (Southern California), and the Center for Genomic Sciences (Pittsburgh).

Dr. Costerton has published more than 640 papers in refereed journals, and has organized many of the pertinent meetings in the burgeoning biofilm field. His research has been recognized by the awarding of two honorary degrees (Guelph and Gent [Belgium]), by the Killam Prize (Canada), and by the Procter & Gamble Prize in Environmental Microbiology (American Society for Microbiology). Dr. Costerton is widely credited with having founded the field of biofilm microbiology.

BIOFILMS: ON THE CUTTING EDGE

Biofilms were first described in the dental field, where they were named "plaque," and studied very successfully at the Forsyth Dental Institute. Dental biofilms were further defined in the "in-house" laboratories of the National Institute of Dental & Craniofacial Research. The biofilm hypothesis simply extended this concept of community growth to surface-adherent microbial populations in all ecosystems. The hypothesis states that bacteria preferentially grow in slime-enclosed microcolonies, and it has now been reinforced to include the properties of these metabolically integrated communities, which include their inherent resistance to antibiotics and to human host defenses.

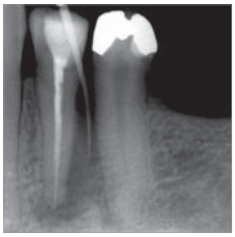
Because biofilm bacteria are very difficult to recover via culture techniques, they are best studied by direct microscopy, and these direct observations have established that biofilms are pivotally involved in virtually all areas of modern dentistry. The attack of bacteria on enamel is mediated by biofilms that focus organic acids in discrete areas (caries), and this form of bacterial growth is also involved in the progressive development of microbial communities which degrade the subgingival areas of the mouth (gingivitis and periodontitis). Biofilms are also involved in the failure of dental implants, root canals, and orthodontic constructs. The general field of biofilm microbiology is currently focused on biofilm control; many new and exciting technologies show promise in the prevention and treatment of biofilms, and these technologies may find their first applications in dentistry—where the whole biofilm story began.

MARK PARHAR, BSc, DMD

Dr. Mark Parhar is currently a third year student in the Graduate Endodontics Program at the UBC Faculty of Dentistry. His research focuses on ultrasonic irrigation devices for improved root canal disinfection. Dr. Parhar has been on the medical staff of the Vancouver Giants Hockey team since 2001 and has been actively involved in sports dentistry. He was the Co-Manager of Dental Services for VANOC Medical Services during the Vancouver 2010 Olympic Winter Games.

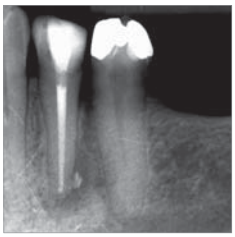
CLINICAL CASE: BIOFILM RESEARCH TO CLINICAL APPLICATIONS IN ENDODONTICS

The survival of bacteria in root canals after treatment is based on the capacity of the individual organisms to adapt to the environment within the tooth. The ability of the organisms in such infections to form biofilms can be seen as the most important adaptive mechanism used by bacteria to survive the environmental changes resulting from the treatment. Consequently, the formation of biofilm may lead to persistent apical periodontitis. With this knowledge, it is imperative that treatment protocols be directed against this type of microbial adaptation.
A patient presented with a persistent infection on tooth 34 that had been treated 2 years earlier. Tooth 34 was treated by non-surgical root canal re-treatment and the treatment details, including the outcome, will be presented.



Pre-operative

Immediate post-operative



Six-month recall

POSTER ABSTRACTS

Poster Competition Judges

DR. MAZEN ALOTAIBI
DR. DIETER BRÖMME
DR. S. ROSS BRYANT
DR. RICARDO CARVALHO
DR. ALAN LOWE
DR. TORU NAITO (Fukuoka, Japan)
DR. CAROLINE NGUYEN
DR. N. DORIN RUSE
DR. RAVINDRA SHAH (Chair)
DR. J. DOUGLAS WATERFIELD
DR. CHRISTOPHER WYATT

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2 **The Role of Smad2 Overexpression and the Progression of Periodontitis**

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3 **Temporary Anchorage Devices in Orthodontics**

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Department of Oral Health Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

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Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

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[1]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]Department of Integrative Oncology, British Columbia Cancer Agency, Vancouver, Canada; [3]Department of Pathology & Laboratory Medicine, Vancouver General Hospital, Vancouver, Canada

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[1]Department of Oral Health Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]General Dentistry, Kyushu University Hospital, Fukuoka, Japan

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[1]BC Oral Cancer Prevention Program, British Columbia Cancer Agency, Vancouver, Canada; [2]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

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MacDonald DS*[1], Li TKL[2], Mok WH[3]

[1]Division of Oral & Maxillofacial Radiology, Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]Oral & Maxillofacial Radiology Practice, Hong Kong, China; [3]Faculty of Dentistry, The University of Hong Kong, Hong Kong, China

22 **Role of Fibroblast Phenotype and Pericellular Matrix in Wound Healing**

Mah W*, Jiang G, Larjava H, Häkkinen L

Laboratory of Periodontal Biology, Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

23 **Oral Appliance Treatment of Obstructive Sleep Apnea: Long-Term Side Effects**

Pliska BT, Nam H*, Chen H, Lowe AA, Almeida FR

Department of Oral Health Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

24 **Acceptance of Innovative Caries Management in a Community Dental Clinic**

Ng C*[1], Campbell K[1], Harrison R[1], Glassby P[2]

[1]Department of Oral Health Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]Vancouver Coastal Health Authority, Vancouver, Canada

25 **Kinetic Characterization of a Novel Class of Anti-Collagenase CatK Inhibitors**

Nicholls AT*[1], Hsu A[2], Brömme D[1]

[1]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]Department of Anatomy & Cell Biology, Faculty of Science, McGill University, Montreal, Canada

26 **Ultrastructural and Biochemical Approaches to Evaluate Type I Collagen Degradation**

Panwar P*, Brömme D

Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

27 **Evaluation of Ultrasonic Irrigation Systems for Root Canal Debris Removal**

Parhar M*, Haapasalo M, Shen Y

Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

28 **Measurement of Apical Pressure Using Positive and Negative Pressure Irrigation**

Park E*, Shen Y, Haapasalo M

Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

29 **The Role of Pannexin-3 in the Formation of Intramembranous Bone**

Rasool A*[1], Bond SR[1], Richman JM[2]

[1]Department of Cellular & Physiological Sciences, Faculty of Science, The University of British Columbia, Vancouver, Canada (UBC); [2]Department of Oral Health Sciences, Faculty of Dentistry, UBC

30 **Mechanism of RAW 264.7 Macrophage-Mediated Depletion of Hydrogen Peroxide**

Rhee TH*, Waterfield JD, Brunette DM
Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

31 **Challenges in Establishing Primary Oral Squamous Cell Carcinoma Cell Lines**

Saini R*[1,2], Garnis C[2,3], Poh CF[1,2]
[1]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada (UBC); [2]Department of Integrative Oncology, British Columbia Cancer Agency, Vancouver, Canada; [3]Division of Otolaryngology, Department of Surgery, Faculty of Medicine, UBC

32 **Oral Health in Inner-City School-Aged Children**

Samim F*[1], Aleksejūnienė J[1], Zed C[2], Mathu-Muju K[1]
[1]Department of Oral Health Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada (UBC); [2]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, UBC

33 **Characterization of Space Maintainers in Specialty Practice: Four-Year Retrospective Study**

Shao S*, Zhao W, Campbell K
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34 **Modulation of Elastase Activity of Cathepsin K**

Sharma V*[1], Brömme D[1,2]
[1]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada (UBC); [2]Department of Biochemistry & Molecular Biology, Faculty of Science, UBC

35 **Cycle Fatigue of Controlled Memory Wire Nickel–Titanium Rotary Instruments**

Shen Y*[1], Qian W[1], Abtin H[1], Gao Y[2], Haapasalo M[1]
[1]Division of Endodontics, Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]State Key Laboratory of Oral Diseases, West China College & Hospital of Stomatology, Sichuan University, Chengdu, China

36 **Regular Dental Screening Facilitates Early Diagnosis of High-Risk Oral Lesions**

Tam DM*[1,2], Biggar H[3], Wu J[4,5], Zhang L[1,2], Poh CF[1,2,6]
[1]Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada (UBC); [2]Cancer Control Research, British Columbia Cancer Agency, Vancouver, Canada (BCCA); [3]College of Dental Hygienists of British Columbia, Victoria, Canada; [4]Division of Radiation Oncology & Developmental Radiotherapeutics, Department of Surgery, Faculty of Medicine, UBC; [5]Head & Neck Radiation Oncology, BCCA; [6]Integrative Oncology, BCCA

37 **Connexins Regulate MMP-1 Expression and Function in Fibroblasts**

Tarzemany R*, Jiang G, Larjava H, Häkkinen L
Laboratory of Periodontal Biology, Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada

38 **Resonance Frequency Analysis of Implants Placed in Grafted Bone**

Tuckey T*[1], Aleksejūnienė J[2], Wyatt C[3], Irinakis T[1]
[1]Division of Periodontics, Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada (UBC); [2]Division of Preventive & Community Dentistry, Department of Oral Health Sciences, Faculty of Dentistry, UBC; [3]Division of Prosthodontics, Department of Oral Health Sciences, Faculty of Dentistry, UBC

39 **Dental Care Access for Children with Special Care Needs**

Vertel N*, Harrison R, Campbell K
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40 **Access to Dental Care: Perceptions of Affordability, Availability and Acceptability**

Wallace B*, MacEntee M, Harrison R
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41 **Effect of Detergents on the Antibacterial Activity of Disinfecting Solutions**

Wang Z*[1,2], Shen Y[1], Haapasalo M[1]
[1]Division of Endodontics, Department of Oral Biological & Medical Sciences, Faculty of Dentistry, The University of British Columbia, Vancouver, Canada; [2]The State Key Laboratory Breeding Base of Basic Science of Stomatology (Hubei-MOST) & Key Laboratory of Oral Biomedicine, Ministry of Education, School & Hospital of Stomatology, Wuhan University, Wuhan, China

42 **The Effect of Peptidase Inhibitor 15 on Skeletal Development**

Yang HJ*, Nimmagadda S, Richman JM
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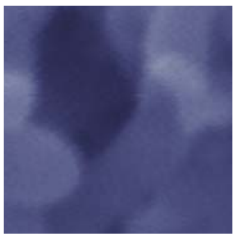

RESEARCH SUPPORTERS

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Canadian Cancer Society / Société canadienne du cancer

Michael Smith Foundation for Health Research

The Terry Fox Research Institute
L'Institut de recherche Terry Fox

BC Cancer Foundation
Supporting research & care at BC Cancer Agency

Vancouver CoastalHealth

Canadian Academy of Endodontics / Académie Canadienne D'endodontie

American Association of Endodontists Foundation

Pacific Otolaryngology Foundation

Child & Family Research Institute

RESEARCH CLUSTERS

- CLINICAL RESEARCH, TECHNOLOGY TRANSFER & DENTAL MATERIALS SCIENCES RESEARCH CLUSTER
- COMMUNITY & EDUCATIONAL RESEARCH CLUSTER
- iMATRIX RESEARCH CLUSTER

CLINICAL RESEARCH, TECHNOLOGY TRANSFER & DENTAL MATERIALS SCIENCES RESEARCH CLUSTER

This cluster encompasses groups engaged in research on cancer diagnosis and prevention, dental biofilms, dental hygiene, dental instruments and materials, dental sleep medicine, forensic dentistry, and interactive dental anatomy. Our areas of expertise include biomaterials, dental morphology, obstructive sleep apnea, oral cancer, and root canal irrigation. We study matters such as bacterial eradication, cellular interactions, cephalometrics, community outreach programs, computational fluid dynamics, diagnostic tools, DNA analysis, fracture mechanisms, molecular markers, novel disinfection strategies, oral care products, surface characterization, and treatment strategies.

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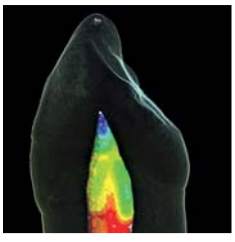
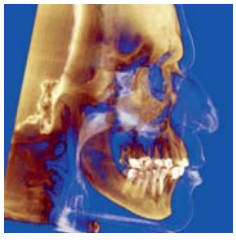
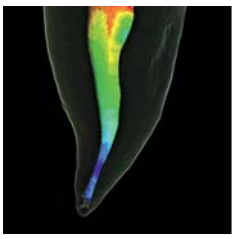


**We welcome our new faculty to UBC.*

Advancing oral health through outstanding education, research, and community service.

COMMUNITY & EDUCATIONAL RESEARCH CLUSTER

The research in this cluster relates to three of the four Canadian Institutes of Health Research themes: health services research; social, cultural, environmental, and population health; and clinical research—and to a range of educational studies. These domains are loosely interconnected and employ various quantitative and qualitative research methods and knowledge transfer. Our members conduct studies on diverse topics such as healthcare promotion, oral implants, dental caries, systematic literature reviews, and community service learning.

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**We welcome our new faculty to UBC.*

iMATRIX RESEARCH CLUSTER

iMatrix is an interactive research cluster combining the research interests of 12 highly-active laboratories in oral and biomedical sciences. We conduct basic science research in areas such as cancer, cell behaviour, craniofacial development, integrins, molecular biology, periodontal disease, proteases, proteomics, and wound healing. Highly-motivated undergraduate and graduate students, post-doctoral fellows and other trainees, as well as interested collaborators, are welcome to contact our member laboratories.
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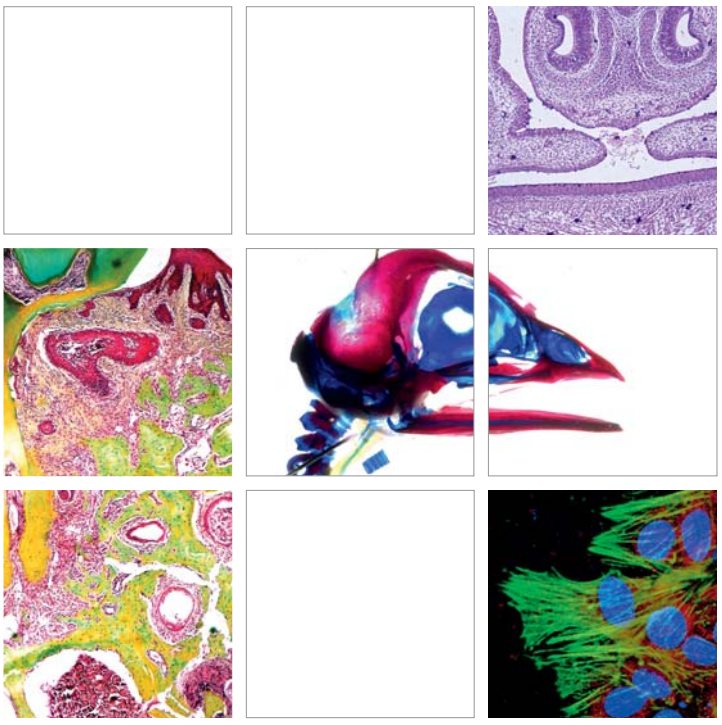

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For more information on graduate programs visit www.dentistry.ubc.ca/grad or contact: Vicki Koulouris vkoulouris@dentistry.ubc.ca T 604 822 4486

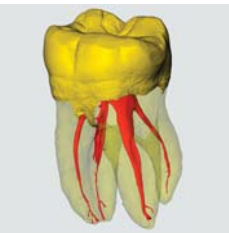
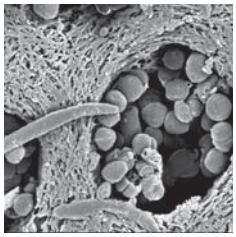
GRADUATE RESEARCH OPPORTUNITIES

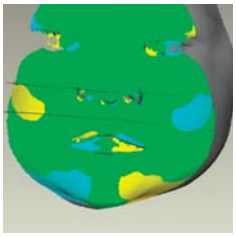
PhD or MSc in Craniofacial Science

The UBC Faculty of Dentistry offers advanced study leading to a PhD or MSc in Craniofacial Science. The PhD program requires the successful completion of a research-specific curriculum, a comprehensive exam, and defense of a research-based thesis. A minimum of four years of full-time study is typically required. The MSc program requires successful completion of a research-specific didactic curriculum in conjunction with a research-based thesis. This program typically requires two years of full-time study; however, an extended part-time option for an MSc degree is available. Research options in one of the following three broad areas of study are available:

- Population health research explores the complex interactions (social, cultural, environmental) that affect the oral health of individuals, communities, and populations.
- Oral health-related clinical research includes both interventional and observational studies focusing on the following: disease prevention, diagnosis, risk, treatment, prognosis, and health care.
- Basic science research in the areas of biomaterials, cell biology, developmental biology, microbiology, and molecular biology.

These graduate programs are available as stand-alone degrees or may be completed as a combined diploma in a clinical specialty with a PhD or MSc degree (see criteria below). Clinical specialty training options are available in the following areas.



Endodontics

PhD or MSc combined with a Diploma in Endodontics
- PhD degree (minimum 6 years) or MSc degree (minimum 3 years)
- Diploma in Endodontics

Graduates will be eligible to take the examinations for specialty certification in endodontics offered by the Royal College of Dentists of Canada and the American Board of Endodontics.

Research Focus
- eradication of microorganisms from the root canal system
- development of unique *in vitro* and *ex vivo* models for biofilms which simulate oral *in vivo* biofilms
- industry collaborations on new devices to improve antimicrobial solutions
- safety and effectiveness of instrument systems to deliver disinfecting agents into the root canal
- impact of file design on the eradication of root canal microbes

Clinical Training
- treatment management (including surgery) of diseases and trauma of the tooth root and pulp

Criteria
- Applicants must hold a DMD or its equivalent
- Application deadline: August 1

Orthodontics

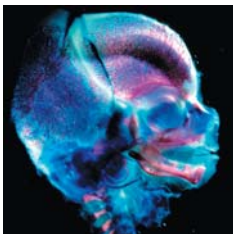
PhD or MSc combined with a Diploma in Orthodontics
- PhD degree (minimum 6 years) or MSc degree (minimum 3 years)
- Diploma in Orthodontics

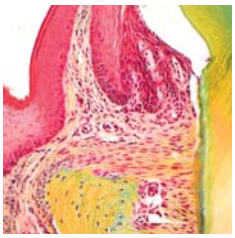
Graduates will be eligible to take the examinations for specialty certification in orthodontics offered by the Royal College of Dentists of Canada and the American Board of Orthodontics.

Research Focus
- craniofacial morphology and function in different populations
- efficiency and efficacy of treatment modalities
- societal and economic strategies that govern access to care
- craniofacial molecular and cellular control mechanisms
- impact of biomaterials on delivering orthodontic mechanics

Clinical Training
- diagnosis, prevention and treatment management of abnormal congenital or developmental relationships of the dentofacial anatomy from infancy to adulthood in diverse populations

Criteria
- Applicants must hold a DMD or its equivalent
- Postgraduate clinical and/or academic experience preferred
- Application deadline: September 1



Pediatric Dentistry

PhD or MSc combined with a Diploma in Pediatric Dentistry
- PhD degree (minimum 6 years) or MSc degree (minimum 3 years)
- Diploma in Pediatric Dentistry

Graduates will be eligible to take the examination for specialty certification in pediatric dentistry offered by the Royal College of Dentists of Canada and the diplomate examination of the American Board of Pediatric Dentistry.

Research Focus
- biomedical research (craniofacial development)
- clinical research (facial symmetry of cleft lip and palate)
- population health and health services research (oral health promotion and access to care for disadvantaged children)

Clinical Training
- diagnostic, preventive, therapeutic and consultative expertise for children and adolescents including those with special healthcare needs at BC Children's Hospital Dental Department, Oral Health Centre at UBC Vancouver, and community settings throughout the province

Criteria
- Applicants must hold a DMD or its equivalent
- Application deadline: October 1

Periodontics

PhD or MSc combined with a Diploma in Periodontics
- PhD degree (minimum 6 years) or MSc degree (minimum 3 years)
- Diploma in Periodontics

This program is recognized by the American Dental Association and the Academy of Periodontology. Graduates will be eligible to take the examination for fellowship in the Royal College of Dentists of Canada and the board examination of the American Academy of Periodontology.

Research Focus
- molecular pathology of periodontal disease
- periodontal and skin wound healing
- clinical aspects of tissue healing around implants
- stem cell-mediated regeneration of lost tissues

Clinical Training
- management of tooth-supporting structures using non-surgical and surgical procedures
- tooth replacement with implants when needed

Criteria
- Applicants must hold a DMD or its equivalent
- Application deadline: September 1


Prosthodontics

PhD or MSc combined with a Diploma in Prosthodontics
- PhD degree (minimum 6 years) or MSc degree (minimum 3 years)
- Diploma in Prosthodontics

Graduates will be eligible to take the examinations for specialty certification in prosthodontics offered by the Royal College of Dentists of Canada and the American Board of Prosthodontics.

Research Focus
- geriatric dentistry
- oral implants and related prostheses
- caries management
- psychosocial aspects of aging
- community healthcare needs

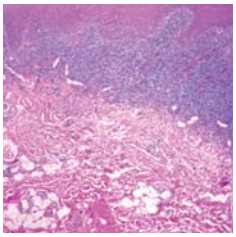
Clinical Training
- diagnosis, restoration and maintenance of oral function, comfort, appearance and health of patients by the restoration of natural teeth and/or the replacement of missing teeth and contiguous oral and maxillofacial tissues with artificial substitutes
  - aesthetics/cosmetic dentistry
  - crowns, bridges, veneers, inlays
  - complete and removable partial dentures
  - dental implants
  - TMD-jaw joint problems
  - traumatic injuries to the structures of the mouth

Criteria
- Applicants must hold a DMD or its equivalent
- Application deadline: October 1

For more information on postgraduate programs visit www.dentistry.ubc.ca/postgrad or contact: Dorothy Stanfield **dstanf@dentistry.ubc.ca** T 604 822 0345

POSTGRADUATE OPPORTUNITIES



General Practice Residency Program

- Advanced postgraduate training in dental specialties in a hospital setting
- Approximately 11 salaried, residency positions per year (one- or two-year)

Applicants choose to apply to the Pediatric Residency, Geriatric Dentistry Residency, or the General Practice Residency. All programs are approved by the Commission on Dental Accreditation of Canada.

A variety of local, provincial and international learning opportunities are available to expand the comprehensive training each resident receives. Community clinics provide oral healthcare to individuals on income assistance, job training and other pre-employment programs. Care to the people of Haida Gwaii supports a community dental health strategy. International experience broadens the scope of learning to understand regional disease processes, treatment modalities and cultural competencies.

Local-Based Residencies

- BC Cancer Agency, BC Children's Hospital, Vancouver Hospital & Health Sciences Centre, St. Paul's Hospital, Portland Community Clinic, First United Oral Health Program, Vancouver Native Health Society (and other community clinics)

Provincial-Based Residencies

- Haida Gwaii (Skidegate and Massett dental clinics), Kelowna Gospel Mission, Prince George Native Friendship Centre, Victoria (Cool Aid Community Health Centre)

International-Based Residencies

- Vietnam (University of Ho Chi Minh, National Hospital of Odonto-Stomatology and Ho Chi Minh City Cancer Centre)
- Cambodia (Angkor Hospital for Children, Siem Reap)
- United Kingdom (Solihull, Queen Elizabeth and Birmingham Children's Hospitals)

Application deadline: October 15

Oral Medicine and Oral Pathology Residency Program

- Hospital-based postgraduate specialist residency
- Three pathways: Oral Medicine (OM, three years), Oral Pathology (OP, three years), or Combined (OMOP, four years)

Completion of any of the three pathways leads to a certificate and eligibility for the Royal College of Dentists of Canada fellowship examinations.

Local hospital-based training sites

- UBC-affiliated teaching hospitals: BC Cancer Agency, Vancouver Hospital & Health Sciences Centre, St. Paul's Hospital

Clinical practice component (training diagnosis, assessment and management)

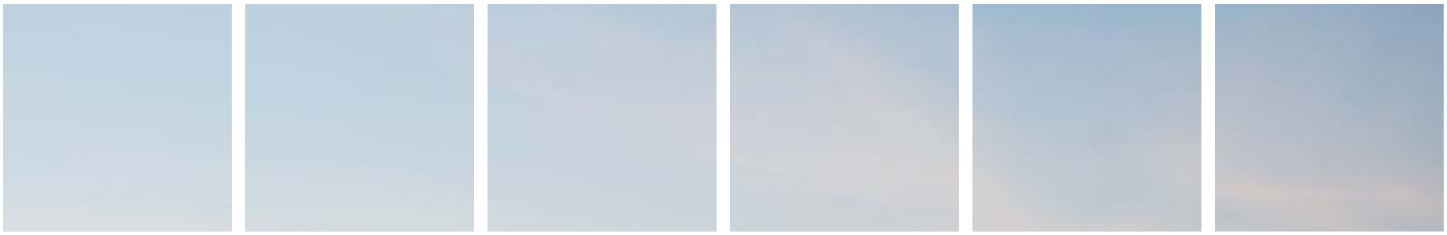
- oral mucosal disease
- orofacial disorders associated with aging, systemic disease and medical therapies
- non-surgical salivary gland disorders
- rotations in anesthesia, internal medicine, rheumatology, neurosciences, dermatology, diagnostic pathology, oncology, otolaryngology, surgical pathology (including autopsy), head and neck pathology, and dermatopathology
- OM pathway: additional training in dental management of medically complex patients and diagnosis and treatment of orofacial pain and neurosensory disorders
- OP pathway: additional training in surgical and anatomical histopathology and laboratory procedures, techniques and diagnosis

Didactic component

- postgraduate-level seminars, case presentations and literature reviews
- teaching rounds
- ongoing basic and/or clinical research studies

Application deadline: November 1

NOTES



NOTES

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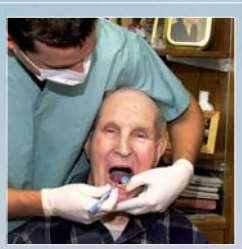
GRADUATE and POSTGRADUATE STUDIES



GRADUATE PROGRAMS

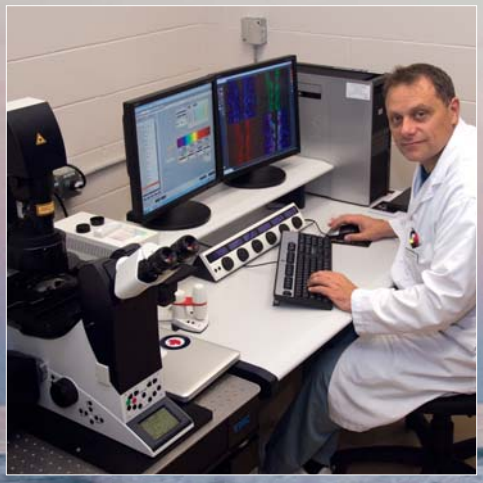
Craniofacial Science

CLINICAL SPECIALTY GRADUATE PROGRAMS

Endodontics
Orthodontics
Pediatric Dentistry
Periodontics
Prosthodonticse

POSTGRADUATE PROGRAMS

General Practice Residency Program
Oral Medicine and Oral Pathology Residency Program



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