

Research Report 09/10

Faculty of
Dentistry



Foreword

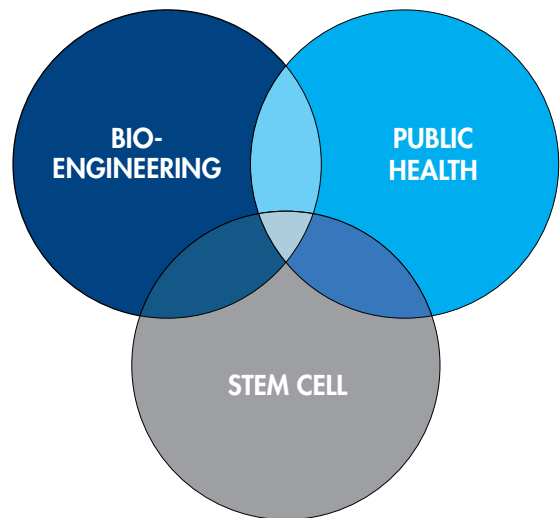
The Dental Faculty would like to position itself to play a key role in the development of new knowledge in dentistry.

The Faculty will leverage on the three major platforms of bioengineering, public health and stem cell research to create impactful knowledge that will assist us in our overall mission to improve oral health through high quality research.

Bioengineering platform covers bio-imaging, biomaterial, tissue engineering, biomechanics, and bio-photonics.

Public Health platform contains epidemiology and oral disease risk assessment and prevention.

Stem Cell platform includes developmental biology, immunology, regenerative medicine, therapy and disease studies.



Associate Professor Cao Tong
Vice Dean (Research)

Vision & Mission

Faculty Vision

To be a Dental Institution of International Distinction

Faculty Mission

To improve Oral Health through Academic Excellence,
High Impact Research and Quality Clinical Service



Research Mission

To improve Craniofacial Health
and the Delivery of Oral Health Care



Graduate Research and Coursework Programme

List of Conferred PhD and MSc Students in AY 2009/10

NAME	MAIN SUPERVISOR	DEGREE	THESIS TITLE
Chung Sew Meng	A/P Adrian Yap	PhD	Development of Depth-sensing Micro-indentation Strategies for characterization of Dental Composites
Dr Sum Chee Peng	A/P Anil Kishen	PhD	Interaction of Enterococcus Faecalis to Root Canal Dentine; Role of Direct Action of Chemicals on Dentine Substrate
Liu Hua	A/P Cao Tong	PhD	Analyzing the Immunobiology of Cultured Mesenchymal Stromal Cells
Do Dang Vinh	A/P Varawan Sae Lim	MSc	Tooth Replantation
Li Mingming	A/P Cao Tong	MSc	Human Embryonic Stem Cells as a Cellular Model for Osteogenesis in Implant Testing and Drug on Discovery
Subakumar Lakshmi	A/P Yeo Jin Fei	MSc	In Vivo/Ex Vivo Osteogenesis of Human Embryonic Stem Cells

List of Conferred MDS Students in AY 2009/10

ORAL & MAXILLOFACIAL SURGERY		
NAME	MAIN SUPERVISOR	RESEARCH TITLE
Soong Poh Lun	Dr Lye Kok Weng	Effect of Orthognathic Surgery on Posterior Airway Space (PAS) in Asian Patients
Teo Bo Tiong Noah	Dr Andrew Tay Ban Guan	Radiographic Signs for Inferior Alveolar Nerve Exposure and Paresthesia Following Third Molar Surgery
Clement Lye Poh Wah	Dr Poon Choy Yoke	A Randomized Clinical Research to Compare Recovery after Bilateral versus Sequential Unilateral Third Molar Surgery in Terms of Health-Related Ability of Life outcomes: Preliminary Findings from a Pilot Study of the First 17 patients
ORTHODONTICS		
NAME	MAIN SUPERVISOR	RESEARCH TITLE
Kaval Jagdish Patel	Prof Murray Clyde Meikle	The Biochemical, Histological and Molecular Studies of Orthodontic Induced Osteopenia in the Alveolar Bone of a Rat: A Preliminary Study
Erica Sham Pui Yin	A/P Kelvin Foong Weng Chiong	Human Masticatory Muscle Dimensions and the Upper Airway - A Morphological Study
Neo Bijuan	A/P Kelvin Foong Weng Chiong	Accuracy of the Dental Cone Beam Computed Tomography in the Avaniitative Measurement of Alveolar Bone Support
Low Gim Hong	A/P Stephen Hsu Chin-Ying	Preventive Effects of Carbon Dioxide Laser Irradiation on Enamel Decalcification around Orthodontic Brackets: An In-Vitro Study
Tang Panmei	A/P Kelvin Foong Weng Chiong	Suitability of Cone Beam Computed Tomography in Detecting Interproximal Carious Lesions
Eugene Wee Chun Kheng	A/P Kelvin Foong Weng Chiong	Three-dimensional Intra-arch and Inter-arch Dental Changes Following Orthodontic Treatment with Premolar Extractions
PERIODONTICS		
NAME	MAIN SUPERVISOR	RESEARCH TITLE
Mehta Payal Manoj	A/P Lim Lum Peng	Non-Surgical Periodontal Treatment on Gingival Response and Interleukin 6 in Patients with or without Diabetes
Ayefa Tariq Sheikh	A/P Lim Lum Peng	Association Between Gingival Recession and Mandibular Symphysis Thickness in Patients who have Undergone Orthodontic Treatment
Wong Li Beng	A/P Lim Lum Peng	Interleukin-1 in Diabetic and Non-Diabetic Individuals with Varying Degree of Periodontal Disease and The Effect of Initial Periodontal Therapy

Undergraduate Research Opportunities Programme (UROP)

Project Title : Influence of Implant Length/ Diameter and Cortical Bone Thickness on Primary Implant Stability

Chua Synn Tian
Goh Zhiwei Desmond
Heng Li Yun
Hsu Wei Cheng
Ng Kay Eng
Nurul Aizat Bin Zainudin
Pwee Yanxiang Gerald

Supervised by

Dr Ng Chee Hon
A/P Adrian Yap U-Jin

Project Title : Protein Expression in Periodontal Ligament Cells Subjected to Cyclic Tensile Strain

Chan Huey Li Deborah
Goh Xian Jun Edwin
Lee Wei Loong Samuel
Leong Kai Lin Irene
Yeo Jing Ting
Yeo Sze Lynn Stephanie
Yong Cuiwei Lydia

Supervised by

Prof Murray C Meikle
A/P Cao Tong

Project Title : Mechanism of Cariostatic Effects of Yakult

Chua Yee Leng
Guay Shikun Darryl
Kieu Li Chong Edgar
Ma Shiqi
Sin Tong

Supervised by

A/P Stephen Hsu
A/P Lee Yuan Kun

Project Title : Preventive Effects of CO2 Laser on Enamel & Root Demineralization caused by Yakult

Ho Shu Jun Cindi
Quek Hui Qi Sheralyn

Supervised by

A/P Stephen Hsu

Project Title : Cytotoxicity Screening of 3D-printed Porous Titanium Scaffolds using Fibroblasts Derived from Human Embryonic Stem Cells

Ang Chui Noy Michelle
Lai Hiu Fong Sarah
Lim Li Zhen
Quek San Oon Shaun
Tan Shao Yong
Woo Sing Yi Joanne
Yee Ruixiang

Supervised by

A/P Cao Tong
A/P Yeo Jin Fei

Project Title : In Vitro Investigation on the Effect of Endodontic Disinfectants on Bacterial Biofilm

Hee David
Koh Ling Na Helena
Lee Xin Theodora
Ng Qiu Ting
Ong Jien Woon Samuel
Tan Jian Xiong
Tan Shyn Lyn

Supervised by

A/P Anil Kishen

Project Title : An In Vitro Testing of CPP-ACP and TCP with Fluoride in Remineralizing Initial Lesions-A Pilot Study

Neo Huiqi Stephanie
Ruebini Anandarajan
Tay Ee Leen
Teo Xingru Cara
Tey Hwee Shin Valerie
Wang Yuan
Yee Hui Xin Sophia

Supervised by

A/P Ngo Hien Chi

FACULTY RESEARCH DAY 2009

The purpose of the Undergraduate Research Opportunities Programme (UROP) is to promote and develop research interest in every undergraduate student within the Faculty. Students work in groups under the supervision and guidance of a research mentor. The programme commences in Year 2 and lasts for about two years. A final research report has to be submitted at the end of the programme and selected groups will then present their research findings during the Faculty Research Day.

Faculty Research Day 2009 was held on 30 October 2009 and a total of seven groups presented their findings to a panel of judges comprising of A/P Kelvin Foong Weng Chiong, A/P Lim Lum Peng and Dr Rahul Nair. The results of the competition were as follows:

	WINNERS (08-03)	1 ST RUNNER UP (08-07)	2 ND RUNNER UP (08-06)
Project Title	Mechanism of Cariostatic Effects of Yakult	Preventive effects of CO2 laser on enamel & root demineralization caused by Yakult	An in vitro testing of CPP-ACP and TCP with fluoride in remineralizing initial lesions - A pilot study
Members	Chua Yee Leng, Guay Shikun Darryl, Kieu Li Chong Edgar, Ma Shiqi, Sin Tong	Ho Shu Jun Cindi , Quek Hui Qi Sheralyn	Cara Teo Xingru, Ruebini Anandarajan, Sophia Yee Hui Xin, Stephanie Neo Huiqi, Tay Ee Leen, Valerie Tey Hwee Shin, Wang Yuan
Supervisor(s)	A/P Stephen Hsu & A/P Lee Yuan Kun	A/P Stephen Hsu	A/P Hien Chi Ngo

Winning Group



From Left: Dr Rahul Nair, A/P Robert Yee, Ma Shiqi, Guay Shikun Darryl, Sin Tong, Kieu Li Chong Edgar, Chua Yee Leng, A/P Stephen Hsu, A/P Kelvin Foong and A/P Lim Lum Peng

1st Runner Up



From Left: Dr Rahul Nair, A/P Robert Yee, Ho Shu Jun Cindi, Quek Hui Qi Sheralyn, A/P Stephen Hsu, A/P Lim Lum Peng and A/P Kelvin Foong

2nd Runner Up



From Left: Dr Rahul Nair, A/P Robert Yee, Valerie Tey Hwee Shin, Tay Ee Leen, Cara Teo Xingru, Stephanie Neo Huiqi, Wang Yuan, Ruebini Anandarajan, Sophia Yee Hui Xin and A/P Lim Lum Peng, A/P Kelvin Foong, A/P Stephen Hsu and A/P Hien Chi Ngo

Research Highlights

UROP-Faculty Research Day Winning Group

(The winning group represented the Faculty at the IADR SEA Division Travel Award under the Junior Researcher Category in Taipei, Taiwan.)

Title of Project	Mechanism of Cariostatic Effects of Yakult																		
Name of Members	Chua Yee Leng, Guay Shikun Darryl, Kieu Li Chong Edgar, Ma Shiqi and Sin Tong																		
Supervisor	A/P Stephen Hsu and A/P Lee Yuan Kun																		
Summary of Project	<p>Objectives: To elucidate possible mechanisms and to verify the effects of short term Yakult® consumption on plaque quality, pH recovery, Mutans Streptococci and Lactobacillus counts after a sucrose challenge.</p> <p>Lactobacilli (LB) counts and salivary buffer capacity were taken for 15 volunteers using Dentocult SM (Strip Mutans®), Dentobuff® Strip, and Dentocult LB® (Orion Diagnostica, Espoo, Finland) test kits respectively. The plaque pH challenge after sucrose challenge (“Stephan curve”) was evaluated at the distal surface of the right upper canine with a palladium-touch pH microelectrode (Orion Research, Inc., Cambridge, MA). In addition, plaque samples retrieved from the same sites were analyzed using RT-PCR techniques. Subjects rinsed daily one bottle of 100ml Yakult® for one week before they returned for follow-up measurements. The difference between baseline and follow-up measurements of the aforementioned variables was analyzed using related parametric and non-parametric statistical tests.</p> <p>Results: The Stephan Curves of participants before and after the intervention period exhibited statistically significant changes. Mean lowest pH increased from 5.02 to 5.22 (p =0.02), mean recovery time decreased from 9.79min to 6.10min (p<0.001) and AUC decreased from 3424 to 1339 (p =0.01). Microbiological analysis with RT-PCR revealed the significant decrease of SM counts (p<0.05). The average log value of S.mutans DNA copies decreased from 11.43 to 7.03.</p> <p>Conclusion: This study confirmed that the short term consumption of Yakult® may cause cariostatic ecological shift of oral biofilm through the reduction of SM and acid production.</p> <div style="display: flex; justify-content: space-around;"> <div> <p style="text-align: center;">Intra-oral pH measurement</p>  </div> <div> <p style="text-align: center;">Changes in Demineralization</p>  </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div> <p style="text-align: center;">Effect of Yakult Rinse on Stephan’s Curve</p>  <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Parameter</th> <th>Before Yakult rinse</th> <th>After Yakult rinse</th> </tr> </thead> <tbody> <tr> <td>AUC</td> <td>~8.0</td> <td>~1.0</td> </tr> <tr> <td>Lowest pH</td> <td>~5.0</td> <td>~5.2</td> </tr> <tr> <td>Recovery Time (min)</td> <td>~9.8</td> <td>~6.1</td> </tr> </tbody> </table> </div> <div> <p style="text-align: center;">Effect of Yakult Rinse on SM Count</p>  <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Time Point</th> <th>Before Yakult rinse</th> <th>After Yakult rinse</th> </tr> </thead> <tbody> <tr> <td>1st Qtr</td> <td>~11.4</td> <td>~7.0</td> </tr> </tbody> </table> </div> </div>	Parameter	Before Yakult rinse	After Yakult rinse	AUC	~8.0	~1.0	Lowest pH	~5.0	~5.2	Recovery Time (min)	~9.8	~6.1	Time Point	Before Yakult rinse	After Yakult rinse	1st Qtr	~11.4	~7.0
Parameter	Before Yakult rinse	After Yakult rinse																	
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1st Qtr	~11.4	~7.0																	

Highlights of Completed Research Projects in FY 2009/10



Caries Risk Assessment for Children in Singapore – Adding Plaque pH as a Risk Indicator

Principal Investigator: A/P Stephen Hsu Chin-Ying

Collaborators: Prof David Koh (SOM, NUS), A/P H Brian Hwang (Biz, NUS),
A/P Teresa Loh - Lee Moon Oi (FOD, NUS) and
Dr Xu Yunjie (SOC, NUS)

Total Project Value: S\$22,808

SUMMARY / ACHIEVEMENTS

Despite the decrease in dental caries rate in developed countries in the last few decades, caries remains the single most common chronic childhood disease with the majority of lesions found in the minority of children, indicating an imperative need to identify high-risk children for early prevention.

The association between plaque acidity and caries has been identified in some studies. As a reflection of multiple microbiological, dietary, salivary factors, and their interactions, plaque pH may serve as a direct and site-specific indicator to help building an accurate caries risk assessment (CRA) model. The objectives of this study are:

- To characterize the plaque pH status of pre school children in Singapore
- To identify the association between plaque pH and other demographic, behavioral and biological factors
- To determine the association between plaque pH and overall caries profile of children
- To evaluate the predictive value of plaque pH in caries increment
- To incorporate plaque pH in CRA models for a better predictive accuracy compared with those without plaque pH

All the objectives were achieved. Furthermore, the miniaturized pH electrode and probes were successfully applied in one student research project to probe the potential probiotic effects of Yakult on oral biofilm. This project won the NUS Outstanding Undergraduate Research award (OUR) with S\$5000 cash award. The student team then participated in the **GC Asia-SEAADE Student Prevention Program Competition** of the 19th South East Asia Association for Dental Education (SEAADE) ASM in Manila in 2008 and received first place.



UG student, Dr Goh Siew Hor, receiving the award for GC Asia-SEAADE Student Prevention Program Competition



Oral Health Attitudes and Periodontal Disease Risk Profile of Adult Diabetics in Singapore

Principal Investigator: A/P Lim Lum Peng

Collaborators: Dr Fidelia Tay (AH), A/P Thai Ah Chuan (SOM, NUS),
Dr Sum Chee Fang (AH), Prof David Koh (COFM, NUS)
and Vivian Ng (COFM, NUS)

Total Project Value: S\$168,065

SUMMARY / ACHIEVEMENTS

Objectives

- To establish baseline data on periodontal disease profile and oral health attitudes of adult diabetics in Singapore
- Compare periodontal status and blood serum markers in adult diabetics with healthy controls before and following periodontal therapy

Materials & Method

Subjects were recruited from two diabetic centres and those attending treatment in the post-graduate dental clinic, NUS. Oral examination was carried out, treatment provided include oral hygiene and non-surgical periodontal therapy. Blood tests were also taken. Patients were reviewed at three and six months.

Results

Arising from the study, the following findings were obtained:

- At baseline, periodontal disease severity was associated with higher HbA1c, HsCRP and salivary cortisol levels
- Oral health attitudes and behaviour of patients with diabetes are similar with the healthy controls. Periodontal disease did not appear to have significant impact on the oral health quality of life of the participants
- Patients with diabetes presented with higher volatile sulphur compounds (VSC) levels. An improvement in VSC was found following periodontal therapy

- There was a significant improvement of periodontal status following simple periodontal therapy irrespective of glycaemic control. Subjects with poor glycaemic control also showed a significant improvement as measured by HbA1c and cholesterol levels
- There was no consistent difference in HsCRP, TNF alpha, Interleukin1 and Interleukin 6 levels of patients with or without diabetes before and following therapy; some differences could be explained by ethnicity

Conclusion

The findings highlight the importance of oral health promotion in the population to improve periodontal health and reduce bad breath. No definitive conclusion could be drawn on the impact of periodontal therapy in reducing the levels of common inflammatory markers associated with periodontitis

Achievements

Eight MDS research students and one PhD candidate were trained as part of their research training. The study provided some insight into the periodontal disease and inflammatory profile of patients with periodontal disease in the local context. Further studies would be needed to explore the link between periodontal disease and systemic/inflammatory factors.



Load Fatigue Performance of Implant-Ceramic Abutment Combinations

Principal Investigator: A/P Keson Tan Beng Choon

Collaborator: Prof Jack I Nicholls (University of Washington)

Total Project Value: S\$91,300 (with Provost Office Funding of S\$54,780)

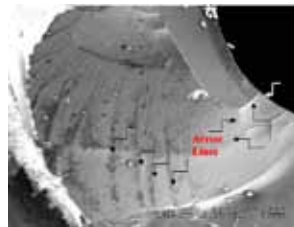
SUMMARY / ACHIEVEMENTS

Ceramic abutments were introduced to meet the demand for ultimate implant aesthetics in the anterior zone. The ceramic abutment-implant combination is an interface involving two dissimilar materials. In addition, conical-abutment connection shave also emerged in newer implant systems with purported platform switching/concave emergence profiles for aesthetic maintenance of the soft tissue cuff. These conical internal connection interfaces have also seen ceramic abutment variants introduced.

Our rotational load fatigue performance protocol elucidated the failure modes of implant-ceramic abutment screw joints and showed clear differences to the conventional metal-to-metal components screw joints. Additional variables were implant diameter (narrow, regular, wide) and interface type (external hex, tricam and press-click internal connection, conical). The study findings reinforce the importance of the clinician weighing the mechanical, biological



Fractured Zr abutment; NobelBiocare Branemark External Hex Procera™ - fatigue failure at 2.046 x 10⁶ cycles



Fractographic Analysis of SEM of specimen; note Origin, Hackles and Arrest Lines.

Fig. 2 Zirconia Abutment Fatigue Failure Mode

and aesthetic considerations before selection of any implant system, connection type or abutment material.

In the first part, four systems with their zirconia(Zr) abutments were investigated. three diameters (Narrow, Regular, Wide) for Replace Select (RS) and Branemark (BM) systems (Nobel Biocare (NB)) and two diameters (4.1mm, 5.0mm) of Osseotite-NT (3i.E) and Osseotite-NT Certain (3i.C) systems (Implant Innovations (3i)) constituted 10 implant-ceramic abutment test-groups. Implant fractures were recorded for NB RS narrow and regular diameter groups (6 out of 15 specimens). Damage of implant platform was observed predominantly in failed specimens of NB BN system. Abutment screw fractures were recorded for Goldtite screws (6 of 20 3i specimens), Torqtite screws (2 of 20 NB specimens) and titanium screws (4 of 10 specimens of NB narrow platform). Abutment fractures were observed in narrow diameter



3i Certain™ 4mm ZiReal Post	3i External Hex 4mm ZiReal Post	NB Replace Select Procera™ Zr	NB BM External Hex Procera™ Zr
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Fig. 1 Zirconia Abutment Systems Failure Modes

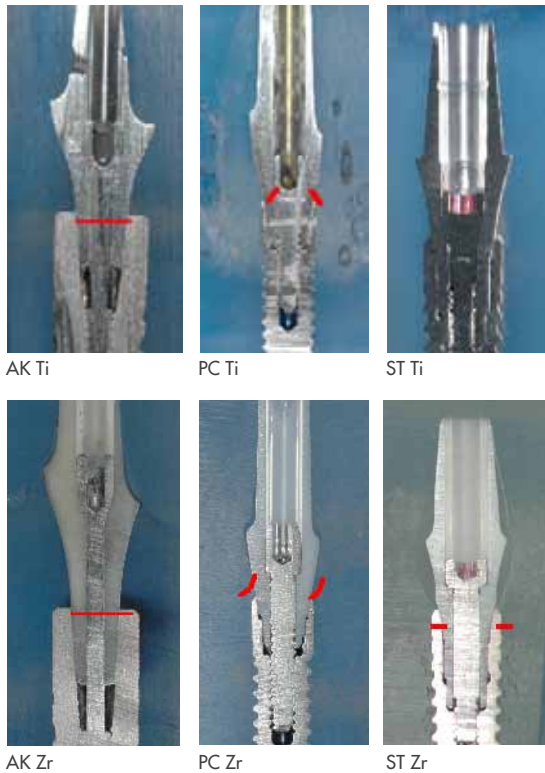


Fig. 3 Conical Abutment Systems Failure Modes

groups (4 of 10) and regular diameter groups (7 of 10) of NB systems. Abutment fractures were also observed in the 4.1 mm diameter groups of 3i systems (5 of 10). There were significant differences between diameters and between the 10 test-groups. Zr abutments failed in more diverse modes compared to previously reported failures of metal abutments. Zr abutment fracture was found to be a significant risk factor in reducing clinical lifespan.

The second sub-study investigated three conical-abutment systems (Dentsply/Friadent Ankylos (AK), Keystone Primaconnex(PC) and Straumann (ST) Bone-Level) with their corresponding titanium(Ti) and Zr abutments. The AK Ti group had 4 abutment fractures (80%) at a level 0.5mm below the platform with concurrent screw fracture (CSF). AK Zr group had five abutment fractures (100%) 0.5mm below the platform level with CSF. PC Ti group had four samples with screw fracture and 1 sample with implant neck fracture and CSF. PC Zr group had five abutment fractures (100%) just below the screw-head seat. ST Ti group had 5 abutment fractures (100%) just above the internal screw thread. ST Zr group had no failures in four out of five samples and 1 failure (20%) just below the screw-head. Fractographic analysis characterized the failure modes. The ST group was significantly different from the AK or PC groups. For Ti abutments alone, there was no difference between systems but for Zr abutments, the ST group was significantly different from the AK and PC groups. Ti conical abutments had poorer load-fatigue performance compared with earlier studies of Ti external-hexagon connections. Zr conical-abutment load-fatigue performance varied and seemed to be system dependant. Many of the failures in both the Ti and Zr conical abutments fractured within the implant and retrieval will pose a significant clinical challenge.



Role of Brain Lysophospholipids in Pain

Principal Investigator: A/P Yeo Jin Fei

Co-Investigator: A/P Ong Wei Yi (SOM, NUS)

Total Project Value: S\$200,000

SUMMARY / ACHIEVEMENTS

Phospholipases A2 (PLA2) cleave sn-2 ester bond in membrane phospholipids to release free fatty acids and lysophospholipids. Mice receiving intracerebroventricular injection of an inhibitor to sPLA2,12-episcalaradial, exhibited significantly decreased responses to von Frey hair stimulation after facial carrageenan injection compared to vehicle injected mice. Lipidomic analysis of the lower medulla of facial carrageenan-injected rats also showed a significant decrease in phospholipids including phosphatidylethanolamine (PE) and phosphatidylcholine (PC), and significant increase in lysophospholipids species such as lysophosphatidylethanolamine (LPE), lysophosphatidylserine (LPS) and

lysophosphatidylinositol (LPI) compared to the controls, indicating an increased PLA2 activity after orofacial pain induced by carrageenan-injection. Quantitative RT-PCR analysis showed high expression of sPLA2-III, sPLA2-XIIA, cPLA2 and iPLA2 mRNA in the upper medulla. Among these isoforms, sPLA2-III showed the highest expression in the lower medulla and its expression was further increased significantly in the carrageenan-injected rats, suggesting the role of this isoform in ascending pain pathway. Similarly, Western blot analysis showed high level of sPLA2-III protein expression in both upper and lower medulla and this enzyme was localized by immunohistochemistry to the spinal trigeminal nucleus and the dorsal- and ventral-horns of the spinal cord. Together the results show an important role of CNS PLA2 in nociception.



Volumetric Modeling of the Muscles of Mastication in Humans from Magnetic Resonance Imaging

Principal Investigator: A/P Kelvin Foong Weng Chiong

Collaborators: A/P Ong Sim Heng (FOE, NUS) and Dr Goh Poh Sun (SOM, NUS)

Total Project Value: S\$60,000

DISCOVERY AND DEVELOPMENT

The muscles that define the way we chew the food we eat, yawn, and any other movements involving the lower jaw are called the muscles of mastication. As a muscle group may be viewed as a three-dimensional structure lying underneath the facial skin, a multi-disciplinary research conducted in NUS, led by the A/P Kelvin Foong of the Faculty of Dentistry, and in collaboration with the Faculty of Engineering (A/P Ong Sim Heng), Yong Loo Lin School of Medicine (Dr Goh Poh Sun) and the A*STAR Biomedical Imaging Laboratory (Dr Ng Hsiao Piau and Prof Wiselaw Nowinski), developed techniques to create three-dimensional models of the muscles of mastication (Fig 1) from two-dimensional slices of magnetic resonance images (Fig 2) that are personalised to the individual.

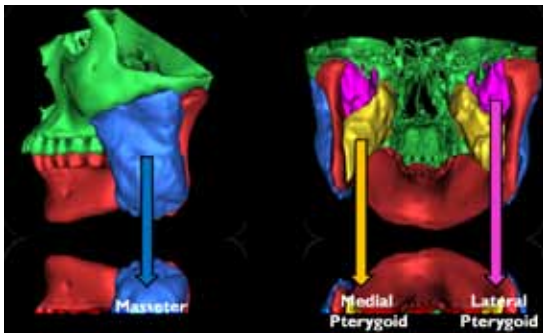


Fig. 1 3D modeling of 3 main masticatory muscle groups

Arising from this research, this team of clinicians and scientists is building on the acquired knowledge to quantitatively model the dimensional changes of the masticatory muscles at various positions of the lower jaw during a chewing cycle. By visualizing the dynamic changes of the masticatory muscles through magnetic resonance imaging, clinicians may have a better understanding of the pathology affecting the masticatory muscles and a valid diagnostic approach to the structural conditions affecting the related temporo-mandibular joints.

In the creation of accurate anatomic models, when enhanced with advanced computer graphics,

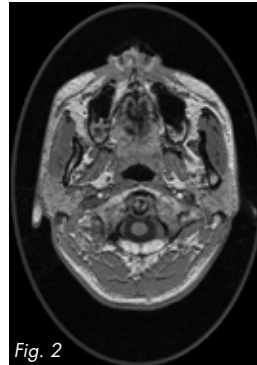


Fig. 2

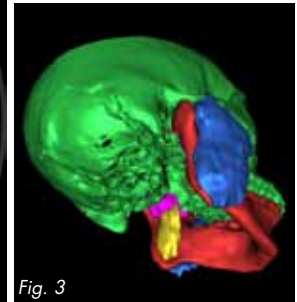


Fig. 3

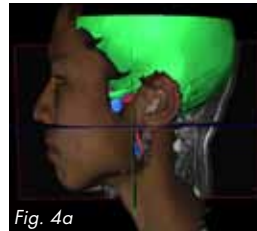


Fig. 4a

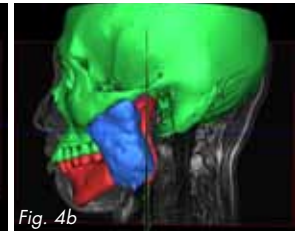


Fig. 4b

there is the additional potential for developing an immersive and interactive environment for the teaching of gross anatomy and applications to surgical anatomy involving the muscles of mastication (Fig 3). With an anatomic model of an individual's muscles of mastication, the potential for the realistic reconstruction of an individual's face through the science of facial approximation is a real possibility where models of the skin, the underlying muscles and jaw bones are layered accurately together by the computer as they are in real life (Fig 4a and Fig 4b). Facial approximation is timely with applications in surgical reconstruction following severe trauma, as well as in the areas forensic and archaeological facial reconstructions.

This completed research project, entitled "Volumetric modeling of the muscles of mastication in humans from magnetic resonance imaging" has been productive with the publication of eight internationally refereed papers and the presentation of six international conference papers. A PhD scholar from the NGS-A*STAR scholarship programme was trained entirely through this research project.



Low Modulus Metallic Implants through Printing

Principal Investigator: A/P Cao Tong

Collaboration with SIMTech A*STAR: Dr John Yong Ming Shyan (PI)

Total Project Value: S\$88,875

SUMMARY / ACHIEVEMENTS

Biocompatibility of novel 3-dimensional printing titanium dental implant with hESCs

FOD, NUS: Mingming LI, Kai LU, Hua LIU, Wei Seong TOH, Xin FU, Jin Fei YEO, Tong CAO (PI)
 SIMTech, A*STAR: Florencia Edith WIRIA, Poon Nian LIM, Francis GOH Chung Wen, John YONG Ming Shyan (PI)



3D printed Ti implant

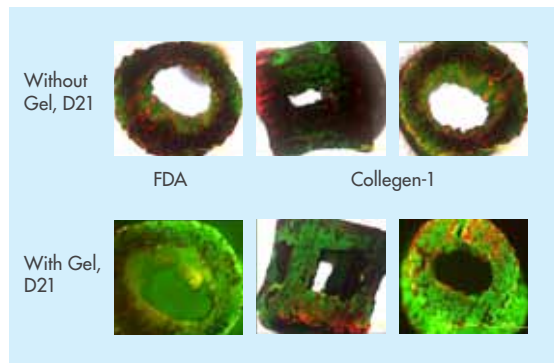
The team recently managed to develop a porous titanium dental implant using 3-dimensional printing (3DP), a powder-based solid freeform fabrication method. The main input in a 3DP process is 3-dimensional computer drawing. It allows the flexibility of design customization, which is beneficial

for implant fabrication as tailoring of implant size and shape helps to ensure the implant would fit nicely for the patient. This study aims to evaluate bio-compatibility of this novel 3DP porous titanium dental implant with human embryonic stem cells (hESCs).

H1 hESCs and human fetal osteoblast cells were seeded onto the 3DP titanium implants independently. After two weeks culture, attached cells were stained by fluorescein diacetate and propidium iodide to assess the cell viability, attachment and migration. The cells seeded in

the 3DP titanium implants were cultured in osteogenic medium. Proliferation was assessed by MTS assay along the time course of differentiation (days 7, 14 and 21). Media was collected every other day up to day 20 and secreted alkaline phosphatase was measured by an enzyme-based colorimetric assay. Co-localization of cell-matrix was examined by collagen type-I and fluorescein diacetate staining. When compared with the negative control, the tested 3DP titanium implants have no cytotoxicity as observed in our MTS results. Both H1 hESCs and human fetal osteoblast cells were able to adhere to the 3DP titanium implants and proliferate well. The cells were able to normally produce collagen type I and alkaline phosphatase in the 3DP titanium implants. Based on in vitro tests, both qualitative and quantitative results suggest that this novel 3DP porous titanium dental implant is highly biocompatible.

H9 VIABILITY AND COLLAGEN-I DESPOSITION



Research Projects Awarded for Funding in FY 2009/10



Project Title: MiRNA Changes in the Frontal Cortex During Orofacial Pain

Principal Investigator: A/P Yeo Jin Fei
 Co-Investigator: A/P Ong Wei Yi (SOM, NUS)
 Total Project Value: S\$60,000



Project Title: The Impact of Oral Health on the Daily Performance of Institutionalised Elderly Singaporeans – a Pilot Study

Principal Investigator: A/P Robert Yee Ting Fai
 Co-Investigator: Dr Rahul Nair
 Total Project Value: S\$172,045



Project Title: Minimally-Invasive Management of Infected Dentine using High-Intensity Focus Ultrasound

Principal Investigator: A/P Jennifer Neo Chew Lian
 Co-Investigator: Prof Khoo Soo Cheong (FOE, NUS)
 Collaborators: Dr Siew-Wan Ohl (A*STAR) and Dr Evert Klasaboer (A*STAR)
 Total Project Value: S\$84,905



Project Title: Evaluation of Caries Risk Assessment Models Among Individuals Undergoing Multi-bracket Therapy (Fixed Orthodontic Appliance)

Principal Investigator: Dr Rahul Nair
 Co-Investigator: A/P Stephen Hsu Chin-Ying
 Collaborators: A/P Robert Yee Ting Fai and Dr Li Xiaobing
 Total Project Value: S\$70,372



Project Title: Identifying Risk of Exacerbation of Asymptomatic Persistent Endodontic Lesions and Building a Risk Assessment Model for Evidence-Based Management of Asymptomatic Persistent Endodontic Lesions

Principal Investigator: Dr Victoria Yu Soo Hoon
 Co-Investigator: A/P Robert Yee Ting Fai
 Total Project Value: S\$104,102



Project Title: Synergetic Biomolecules Delivery to Promote Diabetic Dentoalveolar Regeneration

Principal Investigator: Dr Chang Po-Chun
 Collaborators: Prof Wang Chi Hwa (FOE, NUS) and A/P Lim Lum Peng
 Total Project Value: S\$179,985

Research Collaborations in AY 2009/10

COLLABORATING ORGANISATIONS	YEAR	DEPARTMENT	REGION
UNIVERSITIES			
Harvard University, USA	2004-2010	Oral & Maxillofacial Surgery	International
Shanghai Jiatong University, PRC	2006-2010	Oral & Maxillofacial Surgery	International
Massachusetts General Hospital, Harvard University, USA	2007-2009	Restorative Dentistry	International
Peking University, PRC	2007-2010	Oral & Maxillofacial Surgery	International
University of Otago, New Zealand	2009	Restorative Dentistry	International
University of Texas Health Science Center - San Antonio, USA	2007-2009	Restorative Dentistry	International
University of Wisconsin Madison, USA	2003-2010	Oral & Maxillofacial Surgery	International
Zhejiang University, PRC	2005-2010	Oral & Maxillofacial Surgery	International
University of Iowa, USA	2010-	Oral & Maxillofacial Surgery	International
RESEARCH INSTITUTES			
SIMTech Pte Ltd, A*STAR	2007-2010	Oral & Maxillofacial Surgery	Local
Tissue Modulation Laboratory	2007-2009	Preventive Dentistry	Local

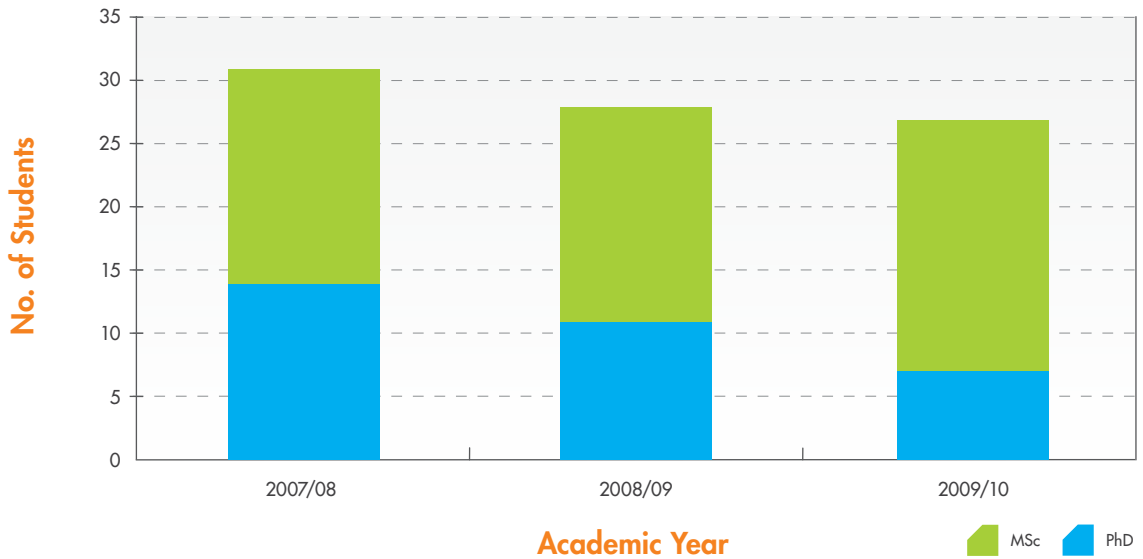
Research Awards and Prizes Awarded in AY 2009/10

AWARDEES	AWARD	INTERNATION/ LOCAL/REGIONAL/ NATIONAL	YEAR AWARDED	AWARDING AGENCY
A/P Cao Tong	Singapore Stem Cell Consortium Grant Award	National	2009	Singapore Stem Cell Consortium, A*STAR
A/P Keson Tan Beng Choon	William R. Laney Award	International	2010	The Academy of Osseointegration (US Based)

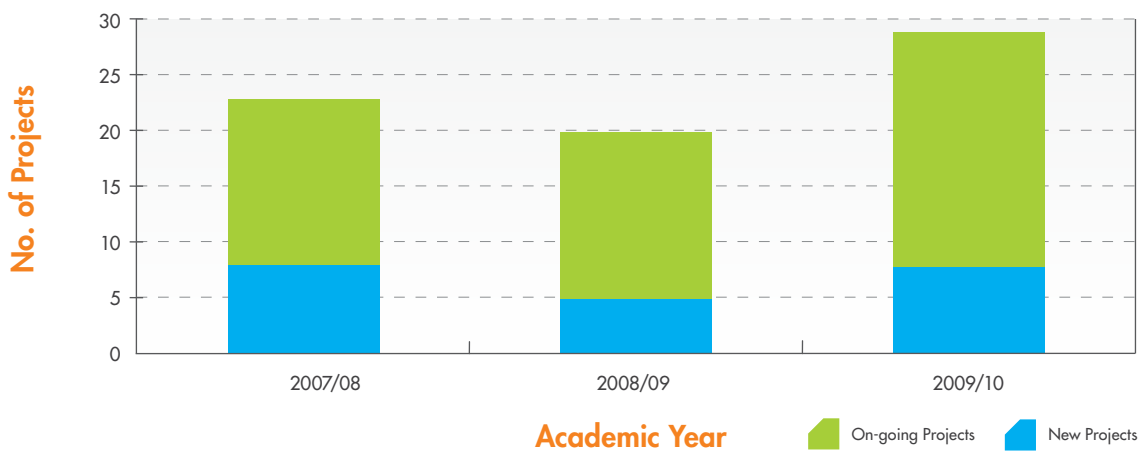
List of Editorial Board Memberships in AY 2009/10

NAME	NAME OF JOURNAL / BOOK SERIES	POSITION HELD
A/P Cao Tong	World Journal of Stem Cells	Editorial Board Member
	Stem Cell Studies	Editorial Board Member
	Chinese Journal of Dental Research	Editorial Board Member
A/P Keng Siong Beng	Singapore Dental Journal	Editorial Reviewer
A/P Lim Lum Peng	Oral Health & Preventive Dentistry	Editorial Board Member
A/P Loh Hong Sai	Saudi Dental Journal	Reviewer
A/P Jennifer Neo Chiew Lian	Journal of Dentistry	Editorial Board
	Operative Dentistry	Editorial Board Member
A/P Keson Tan Beng Choon	Journal of Oral Rehabilitation	Editorial Board
	Journal of Oral Rehabilitation	Editorial Board Member
	Singapore Dental Journal	Editorial Reviewer
A/P Yeo Jin Fei	Singapore Dental Journal	Editorial Reviewer
Prof Loh Hong Sai	Saudi Dental Journal	Reviewer
Prof Murray Meikle	Royal College of Surgeons, Edinburgh. Journal	Editorial Board Member
Dr Chang Po-Chun	American Journal of Applied Sciences	Editorial Board Member
	Journal of Dental Research	Reviewer
	Journal of Periodontology	Reviewer
	PLoS ONE	Reviewer
	Journal of Biomechanics	Reviewer
Dr Clarisse Ng Chai Hoon	Journal of Prosthodontics	Editorial Review Board
Dr Uy Joanne Ngo	Singapore Dental Journal	Editorial Reviewer

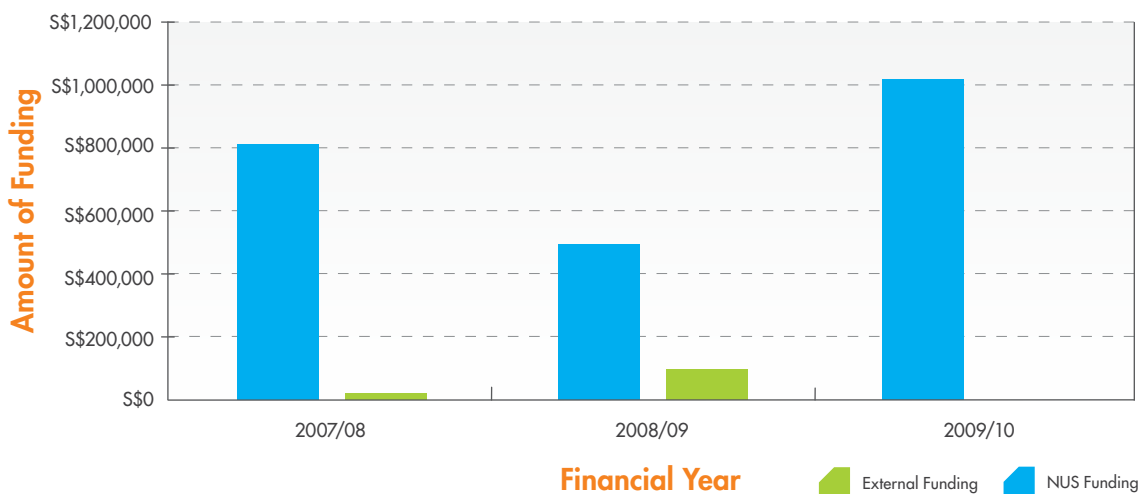
Enrolment of Research Students



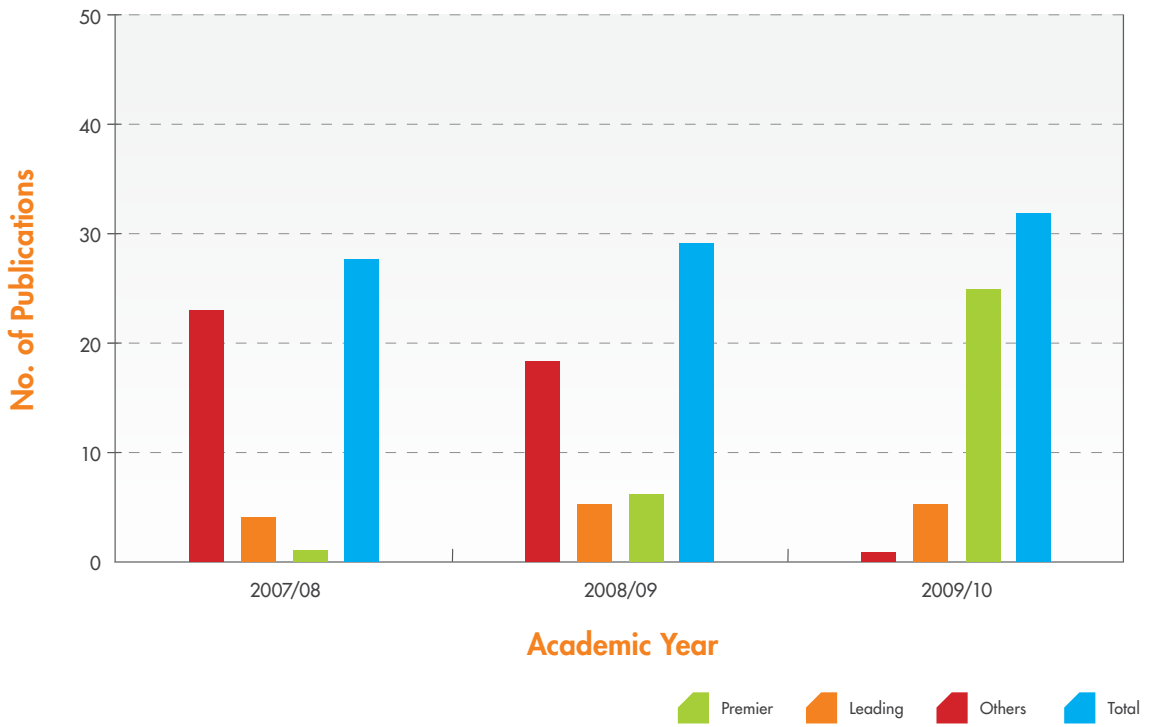
New and On-going Research Projects



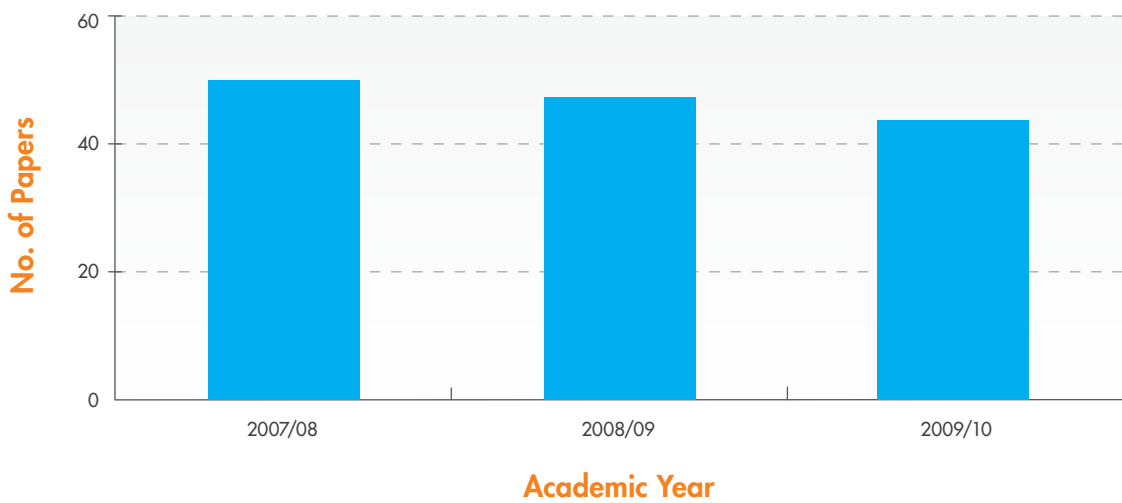
Research Funding



Research Publications



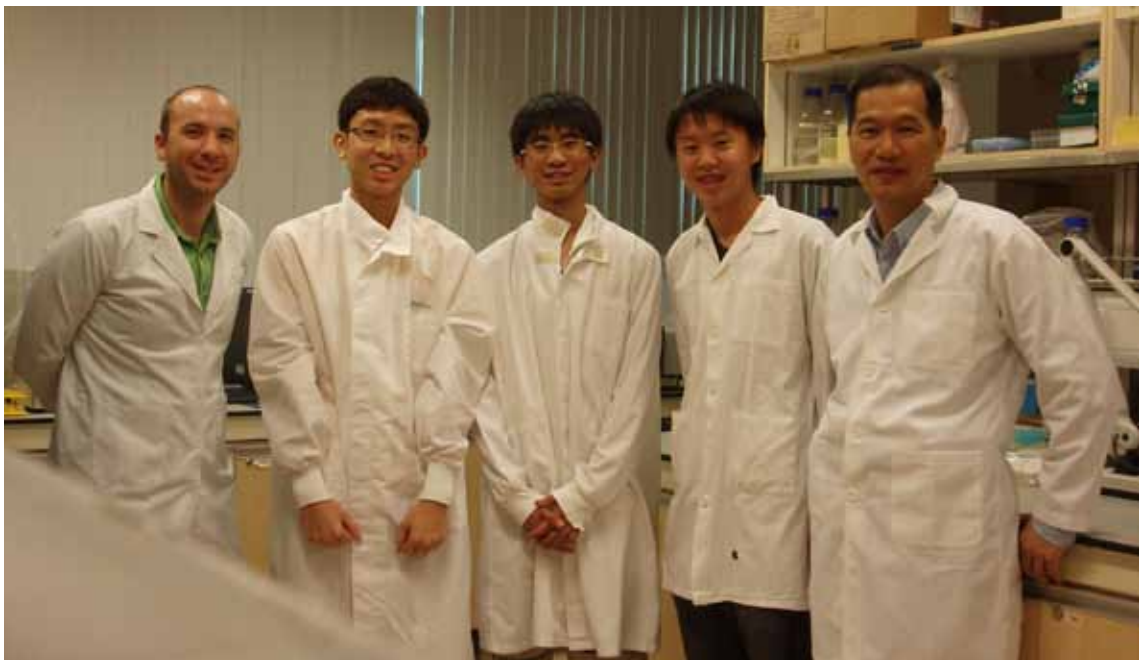
Conference Papers



Research Internships

The Faculty of Dentistry has hosted students from various schools, both locally and internationally as research interns. These schools include Junior Colleges, Polytechnics, and overseas Universities. The duration of the internship varies from a few months to about a year. The internship can either be full-time or part-time. These students receive guidance and supervision from academic staff of the Faculty.

This year, interns from Hwa Chong Junior College (Ang Qianbo Joseph, Lee Jian Xing Clement and Sng Jie Han Timothy) guided by Associate Professor Stephen Hsu participated in Singapore Science and Engineer Fair 2010 (SSEF). The project, entitled "Potential of Barnacle Cement in Dentistry", received one of the 15 gold awards. They were selected to join the International Science and Engineering Fair (ISEF) 2010 and won the Best Group Award. Their achievements did not stop there as the team participated in Singapore Chemical Science Fair 2010 and won the Platinum Award (first prize).

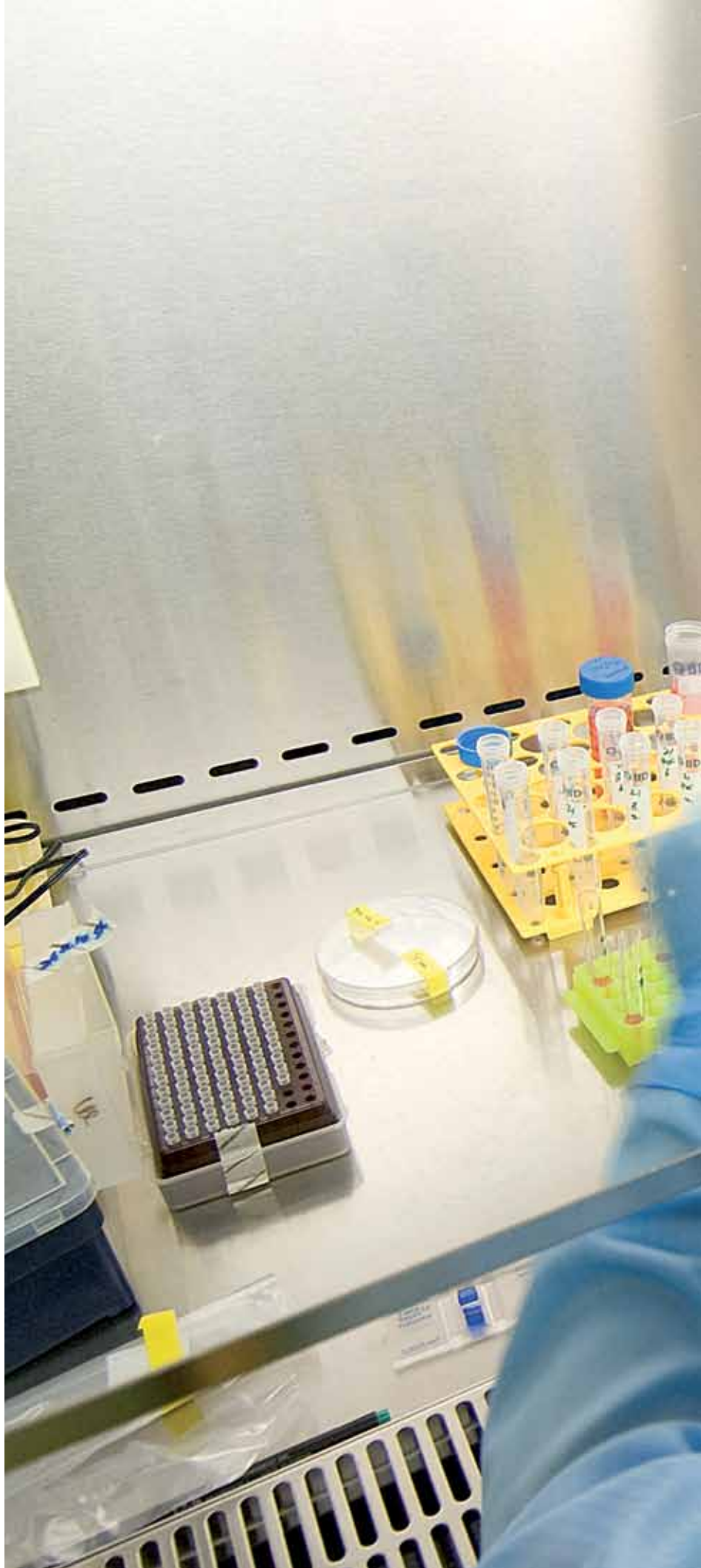


From Left: Co-supervisor Gary Howard Dickinson from Tropical Marine Science Institute, Timothy Sng, Clement Lee, Joseph Ang and Assoc Prof Stephen Hsu. Not in picture: Dr Carolina Un Lam

"Doing research for the past year has taught me a lot about values in life and gave me a new perspective towards research. Having understood how research is not just an activity to produce results, but good training for both the mind and spirit, I have found doing research a delightful activity....All in all, the process of research was inspirational and I have gained much beyond what I could have learnt in a classroom setting. Because of the important lessons I have learnt from research, I feel more ready to take on future challenges and give my best in overcoming them, with a spirit that refuses to give up even when faced with the most impossible boulders"
- Lee Jian Xing Clement

"On hindsight, I felt that Prof Hsu's intention was to put our group through the process of actively and freely searching for a research topic of our choice. In addition, the 1-month of brain-storming also trained our perseverance and team work where our group had to work together by searching for relevant research areas and share our findings.... Finally, our group completed our research paper with the help of Prof Hsu and Dr Gary's encouragement albeit the numerous less than desired results. Prof Hsu then reiterated the greater importance of the process of research, whereby the research team might have unknowingly acquired non-visible skills, such as innovative and thinking ability, determination in the face of insurmountable difficulties and teamwork. Indeed, the outcome might not necessarily be something that we have desired or expected. Still, the very process of working together on an unusual but interesting multi-disciplinary projects (where fields such as dentistry, marine biology, biochemistry, material science are concerned) is the most memorable part of our journey from which we derived the greatest intellectual stimulation and satisfaction." - Sng Jie Han Timothy

"Many of the skills that we picked up on this journey of research is also not just confined to the lab, but can be applied in our everyday lives.....through this project, though we were faced with numerous challenges and obstacles, I believe that in the process of overcoming them, what we have benefitted is more of the intangible as we developed our skills, thinking and character... Indeed, the whole journey on this research project has truly been a wonderful, enriching and inspiring learning experience that has impacted me greatly and I believe, is one that has shaped my thinking, values and goals for the future" - Ang Qianbo Joseph



FACULTY OF DENTISTRY
NATIONAL UNIVERSITY OF SINGAPORE

11 Lower Kent Ridge Road,
Singapore 119083
Telephone: (65) 6772 5340
Facsimile : (65) 6778 5742
<http://www.dentistry.nus.edu.sg>