

NERCC: fostering eye research in New Zealand

The establishment of the National Eye Research and Clinical Centre (NERCC), following the signing of a memorandum of understanding between the Departments of Ophthalmology, Optometry and Vision Science, and Physiology – Molecular Vision Laboratory, has brought together key visual science researchers in New Zealand. These include internationally recognised researchers, as well as several young clinicians and scientists probing the cutting edge of eye research.

Over the last five years several of these researchers have completed, or are investigating, a number of exciting research projects as part of post-graduate research theses such as Master of Science (MSc), Doctor of Medicine (MD) and Doctor of Philosophy (PhD). Current topics include; corneal transplantation, ocular genetics, crystalline lens circulation, formation of cataracts, wavefront aberrations of the eye, *in vivo* confocal microscopy of keratoconus, retinitis pigmentosa, aspects of glaucoma, development of myopia, enhancing spinal cord repair, and the use of antisense technology to modulate gap junctions.

NERCC is taking this opportunity to acknowledge and highlight the contribution of clinicians, scientists and clinician-scientists to ocular research, the increased knowledge of ocular disease and the potential enhancement of treatment modalities. To demonstrate the breadth and diversity of the research currently being conducted, a summary of current and recently completed research theses is outlined in the remainder of this article, the first instalment of a two-part series. We have also included recent graduates and “where they are now” to demonstrate the possibilities that are present following completion of research studies.

Department of Ophthalmology

Dr Christina Grupcheva

PhD thesis: Microstructural and computerised topographic analysis of the cornea in health and disease

Christina graduated with a BSc in mathematics before completing her medical degree at the Medical School in Varna, Bulgaria (1992). She completed her post-graduate training in ophthalmology in Bulgaria with periods in the UK and the USA. She relocated from Varna to Auckland in 1999 to study *in vivo* confocal microscopy of the cornea as the first Maurice and Phyllis Paykel Senior Research Fellow, under the supervision of Professor Charles McGhee. Her thesis developed groundbreaking work on imaging of the cornea by *in vivo* confocal microscopy as well as computerised corneal topography components of the Auckland Cataract Study.

Christina completed her extensive PhD thesis studies in less than 3 years and subsequently was awarded the Vice Chancellor's Prize for the best doctoral thesis in the Faculty of Medical and Health Sciences. More than 25 peer-reviewed publications have resulted from her PhD research! During this period she also completed a full colour atlas of corneal diseases, co-edited with Professor McGhee. Christina was the first PhD graduate of the newly established Department of Ophthalmology.

Christina has been an Honorary Senior Lecturer in the department of ophthalmology since 2003 when she returned to Bulgaria to take up the post of Associate Director in the Specialised Eye Hospital in Varna. In 2005 she was appointed as Assistant Professor in the



Dr Christina Grupcheva, the first PhD graduate from the Department of Ophthalmology, flanked by Professor Charles McGhee and co-supervisor, Dr Trevor Sherwin. (right)

Medical University of Varna. In 2006 she was head-hunted back to Auckland to take up the post of Senior Lecturer in the Department of Optometry and Vision Science.

Dr Gerard Cairns

PhD thesis: The assessment and clinical applications of Orbscan II slit-scanning video-keratography

Gerry studied Optometry at Glasgow Caledonian University and graduated BSc(Hons) in 1995. He was subsequently awarded membership of the college of optometrists (MCOptom) in 1997 and relocated to New Zealand in 1998. He undertook a research fellowship, 2001-2004, under the supervision of Professor Charles McGhee, combining demanding work as principal optometrist in the ADHB ophthalmology department with research studies on computerised corneal topography in the university department.

His PhD studies demonstrated anterior elevation assessment to be one of the strongest features of the Orbscan technique, with an accuracy of approximately 2 microns. The measurement of anterior curvature also closely agreed with a standard Placido-based topography system. These studies also provided the first detailed assessment of posterior elevation topography revealing an accuracy of approximately 10 microns. A model of internal ray-tracing identified edge detection of the scanning slits as one of the most crucial factors in pachymetry determination as any error is enhanced by 66%. The method of edge detection was further implicated in the apparent keratectasia identified following successful LASIK, with the degree of keratectasia more closely associated with increases in light scatter over the posterior slit edges than any other parameter.

Gerry's research led to five major peer-reviewed papers. On completion of his PhD in December 2004, he was head-hunted to the USA and is now based in Rochester, USA, as the Manager, Scientific and Clinical Affairs, Global Vision Care for Bausch & Lomb.

Dr Nisha Sachdev

PhD thesis: Assessing and correlating aspects of human cataract using wavefront aberrometry and Scheimpflug photography

Nisha graduated MBChB from the University of Dundee, Scotland in 1999 and was awarded the AR Moodie prize in Ophthalmology for her undergraduate research.

She relocated to Auckland to continue her pursuit of an academic career in Ophthalmology, commencing her doctoral studies in December 2001, supported by a major research grant from the Maurice and Phyllis Paykel Trust. Under the supervision of Professor Charles McGhee and Dr Trevor Sherwin, Nisha's work involved utilising Scheimpflug photography and wavefront aberrometry to assess higher order optical aberrations to determine objective predictors of visual impairment with cataract and the potential visual benefit of performing cataract surgery – including the effect of intra-ocular lenses on higher order aberration.

Although highly mathematical in approach, this research produced a number of clinically relevant results and has generated international interest, having been presented at several conferences and published in peer-reviewed scientific journals as well as being highlighted as particularly newsworthy in international ocular news publications. Following completion of her PhD, Nisha is now completing her clinical training as a registrar in Ophthalmology in Wellington.



Graduation day (left to right): Dr Trevor Sherwin (Senior Lecturer) with new PhD graduates Dr Gerry Cairns, Dr Nisha Sachdev and Dr Kaa-Sandra Chee.

Dr Dipika V Patel

PhD thesis: In vivo confocal microscopy of the cornea in health and disease

Dipika began her pre-clinical medical training at Cambridge University, obtaining a First Class Honours degree in Physiology, and went on to complete her clinical training at Oxford University. She became a member (MRCOphth) of the Royal College of Ophthalmologists (UK) in 2001.

Dipika joined the Department of Ophthalmology, University of Auckland, as the Maurice and Phyllis Paykel Research Fellow in 2003 for a three-year clinical/research fellowship in cornea and anterior segment with Professor Charles McGhee. During this time she successfully completed her PhD thesis, entitled '*In vivo* confocal microscopy of the cornea in health and disease' and won an award for the best doctoral thesis in the University of Auckland.

Her research has been supported by approximately \$300,000 in research grant funding and has led to approximately 30 publications. She has also presented 14 scientific papers and given two invited lectures at national and international conferences since 2003. Dipika was recently appointed as Senior Lecturer in Ophthalmology,



Dr Dipika Patel with a laser scanning in vivo confocal microscope system.

University of Auckland and will continue research into *in vivo* confocal microscopy of the cornea amongst other topics.

Associate Professor Helen Danesh-Meyer

MD thesis: The evaluation of diagnostic procedures, visual outcome and optic nerve morphology in giant cell arteritis

PhD thesis: Correlating morphology and function of the optic nerve head

Helen completed her MD thesis in 2004 on "The valuation of diagnostic procedures, visual outcome and optic nerve morphology in giant cell arteritis" and is now completing her PhD under the supervision of Professor Charles McGhee and Professor Colin Green.

Completion of this second research doctorate will make her a uniquely (doubly) research qualified ophthalmologist in New Zealand. Helen also leads



Associate Professor Helen Danesh-Meyer MD FRANZCO and Associate Professor Gillian Clover PhD FRANZCO.

and supervises a team of research assistants/fellows within the Department of Ophthalmology undertaking research into various aspects of glaucoma. She has published a textbook and more than 50 scientific articles and chapters - the majority related to glaucoma and neuro-ophthalmology. She combines research and clinical demands, whilst working as a busy glaucoma and neuro-ophthalmology specialist in private and public ophthalmic practice in Auckland. She is the Chairperson of Glaucoma New Zealand.

Her outstanding research output has been recently recognised by the Royal Australian and New Zealand College of Ophthalmologists who have invited her to give the prestigious "Council Lecture" at their annual scientific congress in November 2007.

Dr Wilda Tetuanui Laux-Fenton

PhD thesis in Anatomy with Radiology: The role of connexins in corneal homeostasis and repair: mastering the connections to improve repair

Wilda graduated BSc in 1996 and MSc(Hons) from the University of Auckland in 1998. In 2000 Wilda commenced her PhD study in the Department of Anatomy with Radiology. Her PhD research was on the roles of direct cell-to-cell communication in regulating structure in the cornea of the eye, and in its repair after wounding under the supervision of Professor Colin Green (Ophthalmology). Wilda undertook further post-graduate research in the Department of Ophthalmology for six months after completing her PhD and is now working as an Editor for a scientific writing company and as a science teacher aid.

Dr Sue Ormonde

MD thesis: Assessing pre-operative and outcome parameters of refractive surgery

Sue graduated MBChB from the University of Bristol, UK, in 1992 and completed her vocational ophthalmology training in Manchester. She joined the University of Auckland in January 2001 to undertake a two year clinical and research corneal fellowship supervised by Professor Charles McGhee. During this two-year period she spent half of her time acquiring advanced surgical and clinical skills and the remainder pursuing her MD



Dr Sue Ormonde.

thesis on several aspects of corneal refractive surgery. Sue returned to the UK in 2003 for eight months to complete her higher surgical training for the Royal College of Ophthalmologists (FRCOphth).

More than a dozen peer-reviewed publications have already emanated from Sue's corneal fellowship activities and she was awarded her MD in 2004. Published research includes work on corneal ectasia and posterior corneal curvature following refractive surgery, higher order aberrations of intra-ocular lenses, and severe infective keratitis.

Sue returned to New Zealand in August 2003 to take up the post of Senior Lecturer in Ophthalmology. In addition she is currently a corneal and anterior segment specialist in private and public ophthalmic practice and is the Clinical Director of Ophthalmology, Auckland District Health Board.

Dr Rachael L Niederer

PhD thesis: Assessing the role of the corneal nerve plexus and associated microstructural elements in inherited and acquired corneal disease

Rachael graduated MBChB from the University of Auckland in 2002 and was awarded the Sir William McKenzie Prize in Ophthalmology. Following two years as a junior doctor at Auckland City Hospital she commenced her PhD as the Maurice and Phyllis Paykel Research Fellow under the supervision of Professor Charles McGhee and Dr Trevor Sherwin. Her research explores the role of the corneal nerve plexus and associated microstructural elements in inherited and acquired corneal disease.

Her PhD has extensively investigated the re-innervation of corneal donor buttons following transplantation, and has observed that the re-innervation of the corneal button is slow and nerve architecture appears never to return to normal following transplantation. Her work has also highlighted the reduction in epithelial, keratocyte and endothelial cell density in advanced keratoconus. Her research has already led to seven publications in journals that include top-ranked titles such as "Ophthalmology" and "Investigative Ophthalmology and Visual Science" and it is anticipated she will complete her thesis in 2007.



Dr Rachael Niederer.

Clinical Associate Professor Philip Polkinghorne

MD thesis: Rhegmatogenous retinal detachment: a New Zealand perspective

Philip has completed his extensive research into retinal detachment in New Zealand on a part-time basis over the last four years and submitted his completed MD thesis in July 2007. He is a vitreo-retinal specialist working both in private and public hospital ophthalmic practice. Philip graduated in Medicine from the University of Otago in 1979, completed his Fellowship of the Australian College of Ophthalmologists (FRACO) in 1986 and Fellowship of the Royal College of Ophthalmologists in the UK (FRCOphth) in 1988. He subsequently completed retinal and vitreo-retinal fellowships in Moorfields Eye Hospital, UK.

Since his return to New Zealand he has been active in postgraduate education and research. Philip has some 35 peer-reviewed publications and has also co-authored a major textbook "Management of Diabetic Retinopathy". In recognition of his commitment to clinical research and post-graduate education he was appointed as a Clinical Associate Professor to the Department of Ophthalmology in 2004.



Associate Professor Philip Polkinghorne.

Ilva Rupenthal

PhD thesis in Pharmacy: Ocular delivery of antisense oligonucleotides using colloidal carriers

Ilva graduated with a Bachelor of Pharmacy from the Philipps-University of Marburg in Germany in 2002 and was the first German graduate to apply for a 6-months pre-registration training at the School of Pharmacy, University of Auckland. It was during her internship that Ilva decided to continue her study, which was a joint research project between Pharmacy and Ophthalmology, at a PhD level.

After receiving her registration as a pharmacist in 2004, Ilva returned to New Zealand to commence her studies on the delivery of antisense oligonucleotides to the surface of the eye, supervised by Dr Raid Alany from Pharmacy and Professor Colin Green from Ophthalmology. She was awarded one of only four University of Auckland International Doctoral Scholarships in 2005 and is currently in the final year of her doctoral studies.



Ilva Rupenthal.

Joanne Davidson

PhD thesis in Physiology: Stopping the spread: gap junctions in ischaemia

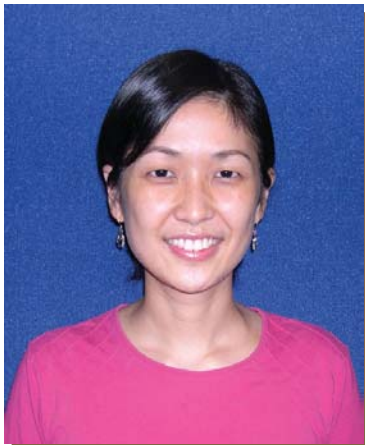
Joanne graduated with a BSc with First Class Honours from the University of Auckland in 2006. She proceeded to commence her PhD in the Department of Physiology under the supervision of Associate Professors Alistair Gunn, Laura Bennet, Louise Nicholson and Professor Colin Green (Ophthalmology). Her research involves studying the role of Connexin 43 gap junctions and hemichannels in the spread of injury following ischaemia in a foetal sheep model of prenatal asphyxia. Joanne currently holds a Top Achievers Doctoral Scholarship.

Ally Chang

PhD thesis in Physiology: The ABC and the XYZ of corneal wound healing

Ally graduated BMedSc with First Class Honours from the University of Auckland in 2003. Ally then took up a research position within the Academia Sinica Research Institute in Taiwan for two years before returning to Auckland to commence her PhD. Ally commenced her PhD in the Department of Ophthalmology in 2006 under the supervision of Dr Trevor Sherwin and Professor Colin Green.

Ally is studying the modulation of limbal stem cells in human corneal wound healing. Corneal limbal stem cells reside within the palisades of Vogt. These stem cells replicate to give rise to one more stem cell and



Ally Chang.

one transient amplifying cell (TAC). These first born TACs replicate rapidly, producing daughter cells that differentiate further and migrate in a centripetal motion to renew the corneal epithelium, according to the widely accepted XYZ hypothesis. Novel experiments are being used to determine whether the XYZ model holds true in a healing human corneal epithelium and also to identify the stem cell contribution to that model. Defining the role of limbal stem cells and TACs in corneal homeostasis and wound healing will demonstrate that modulation of the side population phenotype is possible and beneficial, and may better define the potential of central corneal TACs, thus providing a future therapeutic target to increase the rate and success of epithelial repair in corneal wounds. Ally is supported, in part, by the 2007 Alcon Save Sight Society Research Grant.

Jie Zhang

PhD thesis in Physiology: Enhancing spinal cord repair

Jie graduated with BSc in Biomedical Science with First Class Honours from the University of Auckland in 2007, and immediately commenced her PhD studies in the Department of Ophthalmology on enhancing spinal cord repair using a novel antisense oligodeoxynucleotide technology.

Her PhD project is supervised by Professor Colin Green and Associate Professor Louise Nicholson and is supported by a University of Auckland Doctoral Scholarship.



Jie Zhang.

Dr Hussain Patel

MD thesis: The analysis of eye banking and corneal transplantation in New Zealand

Hussain is a graduate of the University of Otago School of Medicine. Following graduation he worked as a Senior House Officer in Ophthalmology firstly at Wellington Hospital and then at Auckland Hospital. This was followed by a one-year clinical research fellowship with Professor Charles McGhee, Dr Trevor Sherwin and Dr Sue Ormonde at the University of Auckland, where he completed his MD research thesis.

Hussain's MD thesis was awarded in 2007. His work included assessment of adult and paediatric corneal transplantation in NZ as well as assessment parameters for corneal endothelium. These projects resulted in a number of peer-reviewed publications. Interestingly, his work highlighted that paediatric corneal transplantation in New Zealand had a significantly better outcome than internationally reported work – in part due to the earlier age at which surgery for keratoconus is required. Hussain is currently an Ophthalmology Registrar in Auckland and is a trainee of the Royal Australian and New Zealand College of Ophthalmologists.

Dr Catherine Wheeldon

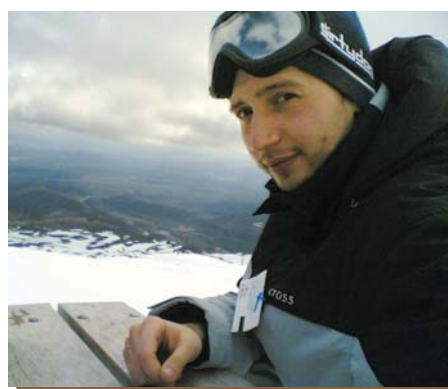
MD thesis: The role of contemporary technology in the assessment, prognosis, and management of anterior segment disease

Catherine is a graduate of the University of Wales College of Medicine, Cardiff, and has a First Class Honours degree in Pharmacology. After achieving her MRCOphth from the Royal College of Ophthalmologists, London she became a Specialist Registrar in Ophthalmology, Newcastle Upon Tyne, England.

Catherine has just completed an eighteen-month clinical research fellowship in Cornea and Anterior Segment with Professor Charles McGhee at the University of Auckland, where she is also completing her MD thesis. Her research interests, contributing towards her thesis include corneal topography and anterior segment imaging. She anticipates submitting the completed work in December 2007.



Ophthalmology Research Fellows celebrating success at the RANZCO conference in Sydney. L to R: Dr Catherine Wheeldon, Dr Taras Papchenko, Dr Rachael Niederer, Professor Charles McGhee, Dr Carole Cooke and Dr Hussain Patel.



Dr Taras Papchenko.

Dr Taras Papchenko

PhD thesis: Development of a rodent ischaemic optic neuropathy model for testing efficacy of antisense technology against gap junctions

Taras graduated MBChB from the University of Auckland Medical School in 2002. Following graduation he worked as a medical House Officer for two years in the Auckland and Waikato regions before spending one year as an NT-Registrar in Ophthalmology. In 2005 Taras was appointed as the (Alcon) Optic Nerve Research Fellow in Ophthalmology, University of Auckland under the supervision of Associate Professor Helen Danesh-Meyer and Professor Colin Green.

His current PhD research work involves the development of a new model of ischaemic optic neuropathy to gain better understanding of the aetiology of this condition and to further use this model for testing of different therapeutic agents. He anticipates completing his PhD in 2008.

Dr Narme Deva

MD thesis: Efficacy of connexin-43 antisense oligodeoxynucleotide gel as an anti-scarring agent in glaucoma filtration surgery.

Narme is a graduate (MBChB) of Auckland Medical School and worked in clinical ophthalmology in New Zealand for two years and in the United Kingdom for one year prior to commencing her present position.

She was appointed as the (Alcon) Glaucoma and Optic Nerve Research Fellow in the Department of Ophthalmology in December 2005. Under the supervision of Associate Professor Helen Danesh-Meyer and Professor Colin Green she is completing a Doctorate in Medicine, evaluating a new anti-scarring agent for use in glaucoma surgery. She anticipates submitting her thesis in 2007.

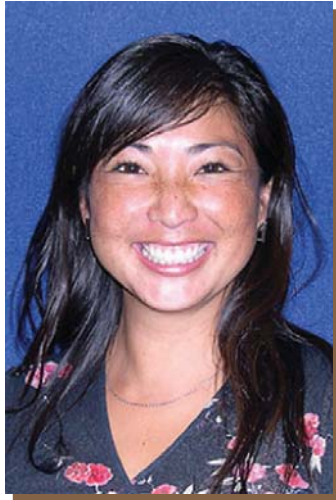


Dr Narme Deva.

NERCC: fostering eye research in New Zealand - Part II

The first article in this two-part series published in the September issue of *NZ Optics* highlighted the contribution of clinicians, scientists and clinician-scientists to ocular research, the increased knowledge of ocular disease, and the potential enhancement of treatment modalities and featured the Department of Ophthalmology. However, equally integral to the NERCC are the Molecular Vision Laboratory in the Department of Physiology and the Department of Optometry and Vision Science, and it is the young scientists in these departments that are featured in this second instalment.

PhD Candidates - Vision Science Laboratory - Department of Physiology



Dr Kaa-Sandra Nardia Chee.

Dr Kaa-Sandra Nardia Chee
Doctor of Philosophy in Biomedical Science

PhD thesis: Roles in cation-chloride cotransporters in maintenance of lens volume and transparency

Kaa-Sandra Chee has recently completed her PhD majoring in biomedical science at the University of Auckland under the supervision of Associate Professor Paul Donaldson, Molecular Vision Laboratory, Department of Physiology. She also has an MSc with first class honours and a BSc in Biological Sciences from Auckland.

During her PhD Kaa-Sandra was a recipient of a Foundation for Research, Science and Technology Bright Futures Top Achiever Scholarship as well as a University of Auckland Doctoral Scholarship. Kaa-Sandra was selected as one of three New Zealand young scientists to attend the Nobel Prize Winners Meeting in Lindau, Germany in 2005 and was a participant in the 2003 Knowledge Wave Conference. She was elected Communications Fellow for the Royal Society of New Zealand in 2001 and participated in "Taking Science to the Streets" as part of the Auckland Festival of Science in the same year. She has a particular interest in communicating science and creating links between science, society and policy.

Between 1999 and 2002, Kaa-Sandra acted as mentor and tutor for Stage One Maori and Pacific students as part of the Tuakana Programme - a leadership development programme initiated by the University of Auckland Business School. In 2005 she was a limited term tutor for the Certificate in Health Sciences for Maori and Pacific students. In 2006 Kaa-Sandra was one of 27 recipients of the National Maori Academic Excellence Award.

Kaa-Sandra is a Postdoctoral Research Fellow in the Department of Ophthalmology investigating corneal wound healing and retinal macular degeneration with Professor Colin Green.

Dr Duane Tearaitoa Kingwell Malcolm
Doctor of Philosophy in Biomedical Engineering

PhD thesis: A computational model of the ocular lens

Duane graduated with a Bachelor of Engineering in Engineering Science from the University of Auckland in 1998. He immediately started a Masters of Engineering, and graduated in 2000. His Masters project involved developing a biaxial rig to measure the mechanical properties of biological membranes. In 2001, Duane started his Doctor of Philosophy studies at the Bioengineering Institute on developing a computational model of the solute and fluid flow in the ocular lens. His PhD research was supervised by Professor Peter Hunter, Associate Professor Paul Donaldson, and Professor Joerg Kistler and was supported by a Bright Futures Enterprise Scholarship.

Duane developed a two-dimensional finite volume model of the transport of fluid and solutes in the lens. Using knowledge of the lens structure and the spatial distribution of transport proteins, the model was able to predict surface and internal transport of the lens. These predictions were consistent with the measured data and the hypothesised microcirculation in the lens. It is hoped that this model will form the foundations of more complex models that will help researchers understand the function and dysfunction of the lens, design experiments and design anti-cataract therapies.

During his doctoral studies, Duane was involved with the Spark Entrepreneurship Challenge as a committee member and later as an entrant. He also developed a strong interest in electronics, web development, programming and linux-based developments.

Duane is currently a researcher and tutor at the Auckland Bioengineering Institute and looks forward to post-doctoral research.



Dr Angus Cheverton Grey.

Dr Angus Cheverton Grey
Doctor of Philosophy in Physiology

PhD thesis: Dynamic expression patterns of major lens membrane proteins

Angus graduated with a Bachelor of Biotechnology with First Class Honours from the University of Auckland in 2001, and immediately commenced his Doctor of Philosophy studies in the Department of Physiology. His PhD research was supervised by Associate Professor Paul Donaldson and involved mapping how the subcellular distribution of two lens membrane proteins changed as a function of lens fibre cell differentiation. Angus was a recipient of a Lottery Health Committee and a University of Auckland Doctoral Scholarship, and in 2002 received the Mary Bullivant Prize from the Physiological Society of New Zealand for the best student presentation at the annual Society meeting.

During his doctoral studies Angus developed an interest in the emerging field of proteomics and is currently undertaking research with Professor

Kevin Schey, a leading lens researcher and Director of the Proteomics Facility, at the Medical University of South Carolina, USA.



Dr Duane Tearaitoa Kingwell Malcolm.

Aran MG Sisley
Doctor of Philosophy in Physiology

PhD thesis: Gap junctions in the lens: is location everything?

Aran Sisley graduated with a Bachelor of Science with First Class Honours from the University of Auckland in 2001, and immediately commenced his Doctor of Philosophy studies in the Department of Physiology. His PhD research was supervised by Associate Professor Paul Donaldson and Dr Christian Soeller. Aran was funded for three years by the Marsden Fund of New Zealand, and in 2004 received a one year project grant-in-aid from the Maurice and Phyllis Paykel Trust. Aran is investigating the contribution of two gap junction subunit proteins, connexins 46 and 50, to intercellular communication in different regions of the rodent lens.

Aran has recently submitted his PhD and is currently preparing to defend his thesis during his oral examination.



Aran MG Sisley.



Kevin Francis Webb.

Kevin Francis Webb
Doctor of Philosophy in Physiology

PhD thesis: Spatial variations in the membrane properties of differentiating fibre cells isolated from the rat lens

Kevin Webb graduated with a Bachelor of Technology in Biomedical Science with First Class Honours from the University of Auckland in 2001 and immediately commenced his Doctor of Philosophy studies in the Department of Physiology. His PhD research was supervised by Associate Professor Paul Donaldson, Professor Joerg Kistler and Associate Professor Gary Housley and supported by a Bright Futures Top Achiever Doctoral Scholarship and a University of Auckland Doctoral Scholarship. Kevin investigated the alterations in membrane ion transport mechanisms during the differentiation of ocular lens fibre cells, a cell type never before studied in this manner.

The ocular lens is largely composed of elongated fibre cells which are retained throughout life in the absence of a blood supply. The mechanism by which fibre cells maintain their viability is thought to depend on an alteration in the membrane properties of fibre cells as they differentiate and become internalised, but this has been difficult to study since these fragile cells degrade rapidly on isolation from the lens. Kevin developed methods to maintain and electrically record from lens fibre cells of a range of lengths and examined how their membrane behaviour was altered in relation to their stage of differentiation. He demonstrated the existence of multiple classes of ion channels and transporters in fibre cells of different lengths, and by relating these lengths to position within the lens was able to provide clues to the fundamental mechanisms which maintain the transparency of the ocular lens.

During his doctoral studies Kevin developed a strong interest in high resolution imaging and is currently employed as a Postdoctoral Research Fellow at University College London, UK investigating the proliferation, migration and differentiation of neuronal stem cells in the developing retina.

Haruna Suzuki
Doctor of Philosophy in Physiology

PhD thesis: Role of purinergic receptors in the ocular lens

Haruna Suzuki was awarded a Bright Futures Top Achiever Doctoral Scholarship (TEC), and is currently in her second year of a PhD in the Molecular Vision Laboratory in the Department of Physiology under the supervision of Associate Professor Paul Donaldson. Her research project focuses on the role of purinergic receptors in the ocular lens. One family of purinergic receptors called P2Y receptors are widely expressed in various tissues and are involved in functions such as cell growth, volume regulation and secretion.

Recently, Haruna was accepted to attend the prestigious Australian Course of Advanced Neuroscience (ACAN) where she will be trained in electrophysiology techniques, which she will then apply to the lens to study the functional properties of these receptors. Overall she hopes this research will contribute to our understanding of the mechanisms involved in lens volume regulation.



Haruna Suzuki.



Nancy Liu.

Nancy (Ju-Wei) Liu
Doctor of Philosophy in Biomedical Engineering and Physiology

PhD thesis: Visualising the lens circulation

Nancy Liu graduated with a Bachelor of Science with First Class Honours from the University of Auckland in 2006 and commenced her PhD in 2007 under the supervision of Associate-Professor Paul Donaldson, Professor Mark Cannell and Dr. Marc Jacobs. Nancy is currently funded by the Biomedical Engineering PhD Scholarship. Her PhD research is focused on the intra- and extra- cellular communication in rodent lens utilising the technique Two-Photon-Excitation-Flash-Photolysis in conjunction with caged-fluorescein or caged-fluorescein-dextran in combination with confocal microscopy. Overall she hopes this research will contribute to our understanding of the mechanisms involved in lens circulation.

PhD Candidates - Department of Optometry and Vision Science

There are currently seven students undertaking their PhDs in the Department and three MSc students. One PhD student (Dr Daniel Sun) has recently completed his PhD and is undertaking post-graduate studies in the United States. The Department has grown considerably on the research front over the past five years with the cohort of post-graduate students providing an invaluable contribution to an evolving research culture within the department. The undergraduate BOptom programme is benefiting from these contributions.

Dr Daniel Sun

Doctor of Philosophy in Optometry

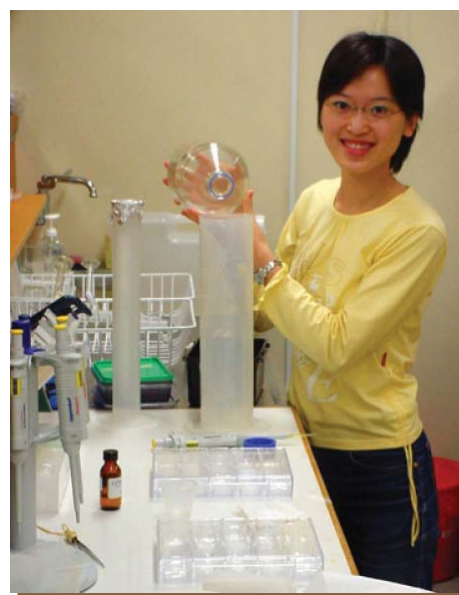
PhD thesis: Neurochemical and functional characterization of the ischaemic/reperfused retina

Daniel Sun has just completed his PhD and has taken a post-doctoral appointment in the Professor Dick Masland laboratory at Harvard. Daniel obtained his optometry degree from the University of Melbourne and an MSc from the same university before moving to Auckland with Professor Kalloniatis to continue his doctoral studies. He was a recipient of a New Zealand Tertiary Education Commission Top Achiever Doctoral Scholarship during his PhD studies.

Ischaemic cell death has been implicated in a number of retinal diseases, including glaucomatous neuropathy, proliferative diabetic retinopathy, and vascular occlusions. The cascade of events leading to cell death involves both a metabolic and functional component. However, it is yet unknown how long these changes persist for following the initial insult, whether all cell classes are affected, and whether there is recovery. The aim of Daniel's thesis was to quantitatively track the recovery in amino acid labelling and functional changes within all retinal cell classes after an ischaemic insult. This study is unique in being able to simultaneously assess retinal amino acid content, cation gating characteristics and function of the ischaemic/reperfused retina. Amino acid neurochemistry and multispectral image analysis were used to assess metabolic integrity and determine cellular identity. The chief findings were: the development of a metabolic and functional profile of the normal and ischaemic/reperfused retina; loss of specific populations of retinal neurons (classified using multispectral image analysis) and finally, neurochemical remodelling in the ischaemic/reperfused retina. These results have important implications in retinal disease: despite cellular survival secondary to retinal disease, retinal circuitry is altered leading to dysfunctional vision.



Dr Daniel Sun.



Rebecca Hu.

to the metabolic relationship between neurons and glia in the retina. With the localisation of glutamine synthetase and glutamate transporters, amino acids including glutamate and glutamine accumulate in the ciliary epithelium for secretion, so that lens amino acid levels can be sustained. The results offer a parsimonious explanation for the common association of altered ciliary body function and cataract secondary to ischaemic insult and provide evidence for highly conserved amino acid metabolic pathways within ocular tissue.

The final stages of the PhD examination process are scheduled for October.

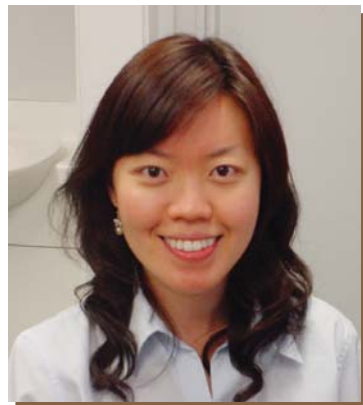
Jacqueline Chua

Doctor of Philosophy in Optometry

PhD thesis: Understanding why photoreceptors degenerate in certain diseases like Retinitis Pigmentosa (RP)

Jacqueline graduated from the University of Melbourne in 2001 with a Bachelor of Optometry and commenced her PhD in 2003 with Professor Michael Kalloniatis. Jacqueline's PhD looks at RP, which is one of a group of inherited retinal diseases that affects approximately 1 in 3000 people worldwide and results in blindness.

Jacqueline's study looks at mapping out inner retinal changes in a mouse model of human RP as a function of disease process as well as identifying cell development and dispersion patterns (work done in collaboration with Professor Tan, University of Melbourne). During retinal disease, retinal anatomical changes and neurochemical changes remodel retinal circuitry. The chief aim of the thesis is to characterise these neurochemical changes, including the time of onset so that any intervention measures (cell rescue or cell transplant), can be targeted at the appropriate time during the degeneration process. The neurochemical component has been undertaken in collaboration with Dr Erica Fletcher (University of Melbourne). Miss Chua has been supported by a HRC funded PhD scholarship and a scholarship through Retina Australia. She is currently at the writing-up phase of her PhD studies.



Jacqueline Chua.

Joanna Black

Doctor of Philosophy in Optometry

PhD thesis: The genetic basis of myopia in dogs

Jo graduated with a BSc in Biological Sciences in 2001 and then completed a BOptom (Hons) in 2005 before starting her PhD, which is supervised by Dr John Phillips. Her PhD investigates the genetic basis of myopia in dogs.

The aims of this study are; (1) to measure refractive error and collect DNA samples in a significant number of related dogs, (2) to investigate the pattern of inheritance of myopia in the dogs and (3) to complete genotyping to identify possible causative loci. Ms Black is supported by a University of Auckland Doctoral Scholarship and by an HC Russell scholarship from the New Zealand Association of Optometrists.



Joanna Black.



Simon Backhouse.

Simon Backhouse

Doctor of Philosophy in Optometry

PhD thesis: Biomechanical and anatomical changes that occur in the sclera with myopia development

Simon Backhouse graduated with a Bachelor of Optometry, First Class Honours, in 2003. He was awarded a University of Auckland Doctoral Scholarship to undertake study towards a PhD in Optometry. He is currently in the fourth year of his PhD and is supervised by Dr John Phillips and Dr Keely Bumsted O'Brien.

Simon is investigating whether the percentage of cells expressing alpha-smooth muscle actin (the marker for myofibroblasts) changes in the sclera of myopic eyes, and whether this is related to the ocular compliance.

Sae Kyung Shin

Doctor of Philosophy in Optometry

PhD thesis: How does the fovea develop such that an area that lacks rod photoreceptors is generated during development?

Sae is currently in the third year of her PhD in the department of Optometry and Vision Science. She is supervised by Dr Keely Bumsted O'Brien. Sae's PhD project is aimed at gaining a better understanding of the human foveal development.

Sae will be carrying her current investigation further to find the changes in gene expression pattern of spatially restricted genes of the optic vesicle before and after ablation analysis by using laser microdissection and quantitative PCR in collaboration with Dr Jan Provis (Australian National University).



Sae Kyung Shin.

Nicola Anstice

Doctor of Philosophy in Optometry

PhD thesis: Contact lenses and childhood myopia

Nicola completed her undergraduate training in 1998 and spent six years working in private practice in New Zealand. After completing her TAPIOT therapeutics course in 2004, she returned to full-time post-graduate study in 2005. Nicola is in the third year of her PhD at the Department of Optometry and Vision Science.

Nicola is conducting a clinical trial (the DIMENZ trial: Dual-focus Inhibition of Myopia Evaluation in New Zealand) to evaluate the efficacy of dual-focus contact lenses in reducing myopia progression. Her PhD thesis investigates DIMENZ and is a randomized, controlled clinical trial involving 40 Auckland schoolchildren. Her PhD is supervised by Dr John Phillips.



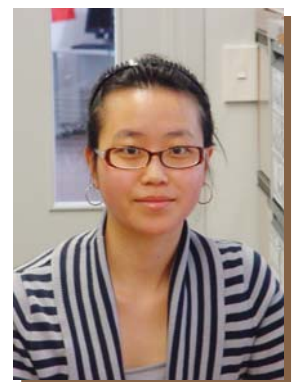
Nicola Anstice.

Silvia Park

Doctor of Philosophy in Optometry

PhD thesis: How starburst cells compute the direction of image motion

Silvia's research is focused on understanding retinal neurophysiology, using a variety of cutting edge techniques from electrophysiology to two-photon imaging. One of the fundamental questions in visual neuroscience is how information about the image motion is processed to generate certain response behaviour. One particular class of retinal neuron, known as the starburst amacrine cell, has been implicated in the computation of directional selectivity. Recently, anatomical data obtained in the Visual Neuroscience Laboratory (VNL) has identified an unusual voltage gated sodium channel, Nav1.8, expressed by starburst amacrine cells. Based on the biophysical properties of this channel, we predict that it is instrumental in producing the directional signal in the retina.



Silvia Park.

Masters Student

Stuti Misra

Thesis: Changes in the second order neurons associated with the absence of rod photoreceptors in a retinitis pigmentosa model

Stuti is an Optometrist from India and her Masters project investigates the use of a cation channel tracking technique (involving the organic cation, agmatine) secondary to glutamate receptor activation. The death of rod photoreceptors is expected to trigger profound changes on second order neurons, particularly in terms of the functionality of those neurons that are associated with the rod pathway, namely bipolar and amacrine cells. The work is following the theme with Professor Kalloniatis's laboratory of understanding neurochemical changes in retinal disease.



Stuti Misra.

The primary aim of Stuti's research is to determine the expression of the ionotropic glutamate receptors involved in the rod pathway as a function of development of the P23H rat model of retinal degeneration. The second aim of her project is to determine whether there are changes in the functionality of second order neurons and immunoreactivity of molecules associated with degeneration.