New Face—TORU welcomes Dr Yong Liang Yang

The Trauma and Orthopaedic Research Unit is fortunate to host Dr Yong Liang Yang for 12 months. Dr Yang is midway through his orthopaedic training at the affiliated hospital of the Shandong Academy of Medical Science and is here on a prestigious Chinese government sponsored scholarship. A/Prof Rachel Li, our lab unit coordinator, has been key in organisation of this project and we hope this will be the first of many such visiting scholars.

The scholarship is primarily a research one but allows Dr Yang to have a day a week clinical exposure as well. Dr Yang attends theatre with consultants who are operating.

Dr Yang is a PhD student in Orthopaedic Surgery at Shandong University, Jinan, in Shandong province, China in order to obtain Doctor of Philosophy degree in Medicine. Dr Yang has published papers in pigmented villonodular synovitis, especially treatment of pigmented villonodular synovitis with total joint replacement and the expression and potential roles of bcl-2, MMP-9 and PCNA in pigmented villonodular synovitis. He is participating in the second edition of “The Pelvis and Acetabulum Traumatology” so he will enjoy working with Prof Smith. Welcome Dr Yang.

Trauma retrieval studies shed light on clinical decisions

Long Distance Damage Control—is it worth it?

Rural patients are 50% more likely to die as a result of trauma, yet despite this, rural trauma is poorly represented within the trauma community both in Australia and overseas.

Most experiences with trauma systems describe an urban system of care which may not account for the complexities associated with rural trauma patients, such as: Poor road conditions, country lifestyles with low adherence to farm safe strategies, greater time and distance to definitive care, as well as being limited by resources and manpower.

Lack of awareness and social action by rural communities has been reported as due to this population believing in the adequacy of their medical system, which then results in little attention being paid to the development of an organised trauma system within rural setting.

High quality early and definitive trauma care in regional hospitals requires a robust system of care. Tertiary trauma hospitals should support, advise, retrieve and return seriously injured patients to their regional hospitals. However, in order to achieve this, education and training of staff in trauma management must be facilitated and research to improve management techniques encouraged.

The trauma system starts at the roadside or scene of injury, with pre-hospital assessment and stabilisation, transport, pre-hospital triage, emergency reception and resuscitation, surgical and intensive care management and rehabilitation and convalescence. Each step is important in the eventual recovery of the patient, as without an integrated approach, there is a high chance that errors will occur in patient management.

The Canberra Hospital (TCH) is a 500 bed Level One trauma and tertiary referral centre which on average treats approx. 60,000 ED presentations per year. In 2004/5 Greater Southern Area Health Service admitted a total of 7248 trauma patients. The majority of these patients required admission for minor to moderate injuries; however 370 patients were designated as major trauma patients who more often than not require complex level care at a MTC. Within that same year, TCH received 29% (108 patients) of these admis-
The knee simulator laboratory was officially opened at ADFA on 9th October 2009

The laboratory was opened by Minister for Health Katy Gallagher, with ADFA Commandant AIRCDRE Margaret Staib, Rector of UNSW at ADFA Professor John Baird, Dean ANU College of Medicine Biology and Environment Prof Nicholas Glasgow, CEO Peter Williams and Dr David Hardman of John James Foundation, Canberra Hospital General Manager Anna Thornton, Executive Director of Surgical and Critical Care Services TCH Barbara Reid, and Professor Brian Lees Head of the School of Physical Environmental and Mathematical Sciences.

The Minister told us how 1000 knee replacements are done in the ACT and rising each year. The minister was delighted to see such collaboration between the areas of education and health in working towards important issues using the resources of knowledge intelligence and clinical background each has. She congratulated the ANU, UNSW at ADFA and Canberra Hospital teams for their work and thanked the John James Foundation for supporting the purchase of the knee simulator.

Total knee replacements are now the most common joint replacement and 35 000 new knees were implanted in 2007. In 2004 knee replacements overtaken hip replacements as the most common joint replaced, with 28 003 implanted in that year. The number of knee replacements rises each year, and the age of people having them gets younger. The research and design to ensure that joint replacements last as long as possible becomes ever more important.

The new knee simulator laboratory at UNSW@ADFA is the outcome of collaborative research between the research groups of A/Prof Paul Smith, Orthopaedic Surgeon, ANU Medical School and Director of the Trauma and Orthopaedic Research Unit, and Dr Heiko Timmers, Nuclear Physicist at UNSW@ADFA. It was purchased with support of John James Foundation.

This laboratory has been set up to label for the polyethylene bearings in the knee replacement with radioisotope. This means wear can be measured on an atomic scale. The laboratory is also able to capture and image the tiny wear particles with an atomic force microscope so the shape and size of the particles can be examined. This is the reaction of these tiny particles of polyethylene debris that starts an immune response that causes loosening of the knee replacement in the bone.

Picture:
Minister Katy Gallagher and John James Foundation’s David Hardman, place the plaque on the new simulator.
Medical Student Projects

In 2008 – 09 medical students have been conducting research projects in the Trauma and Orthopaedic Research Unit. The students are enrolled in the Postgraduate Medicine Program at the Australian National University. The students each conduct a research project as part of their course-work.

Renata Ganko analysed the cases of pelvic fractures requiring surgical fixation. The most common causes were car, then motor bike and blunt trauma injuries. Males made up 74% of the group. This paper is different from others published in the field, in that it looks at just surgically managed pelvic fractures, so the demographics and mechanism of injury are quite distinct from those conservatively managed.

Ross Penglase examined fixation of suprapubic ramus fractures of the pelvis by percutaneous screws and found CT images, that being female, having a smaller, more curved pelvis, made screw fixation more difficult.

John Robillard examined pelvic fixation by iliosacral screws and measured the characteristics of the shape of the sacrum that add complexity to this method of fixation.

Roberto Orefice explored integrity of the medical ankle ligaments using ultrasound. It may be possible to use ultrasound to examine the damage to these ligaments in people with ankle fractures, and if they are intact, the clinical management of these fractures can be simplified.

Michael Jenkins conducted the retrospective aspect of the study entitled “Preventing the second fracture: screening for osteoporosis in fracture clinic.” Osteoporosis is an emerging issue as our lifestyles change and our population ages.

Final year medical students Tom Ward and Sarah Stephens also contributed to the work of TORU; Tom has been integral to the image registration work (page 8) and Sarah to the morphology of the pelvis in greater trochanteric pain syndrome.

These papers were all presented at the Australian Orthopaedic Association ACT Branch meeting this month.

Investigation on the Effect of Suction Ports of Femur Strength

The most effective treatment of femoral shaft fractures is by intramedullary nailing. The procedure itself poses little risk to the patient, however respiratory complications arising from pressure increases within the bone can be fatal. One possible solution, recently developed by A/Prof Paul Smith and his colleagues at TORU is a suction system.

For her final year honours project, ANU Engineering student Mel Fox investigated the effect that the holes, required for the proposed suction system would have on the strength of the human femur. The investigation involved finite element analysis (FEA), with models analysed through the ANU’s super-computing facilities and experimental testing of synthetic femurs using ANU’s mechanical testing ‘Instron’ machine. The scenarios investigated involved suction ports being placed, laterally, anteriorly and posteriorly.

The results of FEA demonstrated that placing the suction ports anteriorly had little effect on the strength of the bone, compared with the case where suction ports were not present. By comparison, positioning suction ports laterally increased the stresses experienced by the femur by up to 300%. The FE models were validated by the experimental work with the high stress areas being accurately predicted in addition to the locations of failure under compressive loadings.

If suction ports are positioned anteriorly in the bone, the suction system is biomechanically viable as no significant reduction in bone strength was observed.

Mel’s work was supervised by Dr Shankar Kalyanasundaram and Dr Zbigniew Stachurski at Department of Engineering.

Mel Fox has just completed her honours thesis in Engineering at ANU, using finite element analysis to test the effect of intramedullary suction ports on femur strength, and then validated this with an experimental test.
GUEST SPEAKER: A/Prof David Little.
Manipulation of anabolic and catabolic responses in bone repair.

Muscle Contribution to Fracture Repair
Current Trends in management of SCFE and osteonecrosis in adolescents

Papers:
• Preventing the second fracture. M Van Twest, J Scarvell, P Smith, S Stanton, A Fisher, E O’Brien, G Buirski
• Operative management of proximal humeral fractures. T Marshall, A Sefton
• Early mortality post intracapsular fractured neck of femur. I Policinski, P Smith
• Comparison of the outcomes of fat embolism syndrome following intramedullary nailing of femoral and tibial fractures. J Smith, T Marshall
• Claiming compensation negatively influences longer term health status for people with soft tissue injuries following road traffic crashes: Emergency department inception cohort study. S Littleton, T Marshall, S Poustie, B Robinson, D Hughes, P Smith
• Group physiotherapy provides similar outcomes for patients after joint replacement surgery as one-to-one physiotherapy: A sequential cohort study. C Coulter, J Weber, J Scarvell
• Tendoachilles injuries at the Canberra Hospital: A case review. A Sefton, T Marshall, C Boultun
• Fat, female and over 40: Fact or fiction? Angela Fearon, J Scarvell, J Cook, P Smith
• When eyeballing x-rays is not good enough. A Fearon, S Stephens, P Smith, J Scarvell
• Crash incompatibility: Are curtain airbags really international best practice against 4WD Killers? J Slater
• Experimental analysis and finite element validation of the effects of intramedullary suction ports on bone strength in fractured and nailed synthetic femurs. M Fox, R Krowka, S Kalyanasundaram, Z Stachurski, J Scarvell, P Smith
• The sensitivity and specificity of ultrasound imaging for the deltoid ligament complex of the ankle: Part 1. Ultrasound anatomy of the intact ankle. R Orefice, M Preda, J Scarvell, J Cook, P Smith, G Buirski
• Osteoid osteoma. Experience of bone tumour unit at RPAH. K Arogundade, C Buchan, R Waugh, P Stalley
• Causes and outcomes of surgically operable pelvic fractures. R Gariko, J Scarvell, R Miller, P Smith
• Isolated comminuted fracture of the trapezium: A case report & discussion of literature. M Suthersan, S Chan
• Anterior supine muscle sparing approach to the hip. C Ahrens
• An orthopaedic study in Anglo-Saxon England. M Van Twest

Program of the ACT AOA Scientific Meeting, 27 Nov 2009

• Alignment of the femoral component in an anatomic modular total knee arthroplasty. M Ahmed, AMoghadam, P Smith
• A comparison of fixed flexion after computer navigated vs conventional knee replacement. M Laird, G Kirsh, J Kaplan
• MRI kinematics of the PCL deficient knee. S Chandrasekaran, J Scarvell, P Smith, K Woods
• A new multimodal similarity measure for prospective kinematic analysis of joints. M Abdullah Al, M Pickering, J Scarvell, P Smith
• Three dimensional dimensional characteristics of UHMWPE wear debris. L Gladkis, H Timmers, J Scarvell, P Smith
• Radiosotope tracing the metal-on-polymer wear debris. J Warner, L Gladkis, Ts Geruschke, R Vianeden, P Smith, J Scarvell, W Zeitz, H Timmers
• Development of osteoclasts cell culture using poly-L-lysine coated cover slip. M Chen, P Smith, R Li
• Monobutyrin as a novel factor linking fat gain and bone loss. R Li, P Smith
• Slipped capital femoral epiphysis treated by surgical hip dislocation and subcapital corrective osteotomy – early experience. R Hocking
• Joint preserving reconstruction for severe hip deformity in children and young adults. R Hocking
• A biomechanical analysis of single column fixed angle (locked) plates versus dual column (non-locked) plates in pilon fractures. A Nair, J Scarvell, Z Stachurski, P Smith
• The effects of high frequency, low magnitude mechanical vibration using the Juvent Dynamic Motion Therapy Device on fracture healing in oestrogen deficient rodent models. I Nizam, R Oliver, W Walsh
• Prevention of ischaemic damage to skeletal muscle. Paul Smith
• MRI changes in menisci of the symptom free but ageing knee. G Stubbs
• Management of solitary renal cell carcinoma metastases to bone. A Burns

Posters:
• Experience with SR TMC arthroplasty. C Lai, A Kadir, S Jansen
• The Lincolnshire Knee: two simple tricks how to improve surgical exposure when performing TKR in obese patients. C Ahrens
• Case Study: Hoffa fractures in an 11 year old male. Mansoor Ahmed, A Burns Dislocation of the hallucal interphalangeal joint with interposition of a sesamoid bone. M Suthersan, B Thomas
• Osteoporosis: The forgotten diagnosis. A retrospective audit of patients presenting with fractures for osteoporosis management. M Jenkins, P Smith, J Scarvell
• Differences in superior pubic ramus anatomy between males and females in the context of percutaneous retrograde superior pubic ramus screws. R Penglase, J Scarvell, T Neeman, P Smith
• Analysis of Sacral ala anatomy for iliosacral screw insertion. J Robillard, J Scarvell, P Smith
Journal Articles  (selected papers 2007-2009)


Qian Xu, Li-Ping Sun, Yue-Hua Gong, Ying Xu, Xi-Jun Yu, Nan-Nan Dong, G David Lin, Paul N Smith, Rachel W Li. Risk of gastric cancer is associated with the MUC1 568 A/G polymorphism. International Journal of Oncology 35: 1313-1320, 2009


Igor Policinski; Smith PN. Case Report: Chronic inflammatory demyelinating polyneuropathy a severe exacerbation post total knee replacement. Journal of Orthopaedic Research, Accepted July 2009


Lin GD, Li RW, Myers SP, Leach DN. A Method of Selecting Plants with Anti-Inflammatory Potential for Pharmaco logical Study. Natural Product Communications. 3(1), 71-76, 2008


TORU’s People

Assoc Prof Paul Smith, BMBS FRACS (Ortho). Director

Assoc. Prof Smith is an orthopaedic surgeon at the Canberra Hospital and at Calvary John James Hospital in Canberra. He is also Co-Director of the Trauma and Orthopaedic Research Unit at the Canberra Hospital. Assoc. Prof Smith is also president of the Arthroplasty Society of Australia, and Clinical Director of Orthopaedic surgery at the Canberra Hospital.

Assoc. Prof Smith received his medical and surgical training in Adelaide before specialising in hip and knee joint reconstructive and replacement surgery. He was a Royal Australasian College of Surgeons Travelling Fellow in 1996 and 1997 with Fellowships in joint replacement surgery at the University of Western Ontario in Canada and at The Princess Elizabeth Orthopaedic Hospital in England. He has recently been honoured by The Knee Society, receiving the inaugural John N Insall Travelling Fellowship in knee surgery and has been appointed as Associate Professor in Orthopaedic Surgery at the ANU Medical School. Assoc. Prof Smith’s particular clinical interests are in reconstruction and replacement surgery of the hip and knee, complex revision joint replacement surgery and management of pelvic and acetabular injuries.

Contact:
smithadmin@co.net.au

Dr Damian McMahon, MB BS FRACS. Director

Dr McMahon is the Director of the Shock Trauma Service, Senior Staff Specialist in surgery and Co-Director of the Trauma and Orthopaedic Research Unit at the Canberra Hospital. In addition, Dr McMahon is the Director of the Clinical Skills Centre and Senior Lecturer in surgery at the Australian National University Medical School.

Dr McMahon received his medical and surgical training in Melbourne where he specialised in Trauma Surgery. He became Trauma Service Coordinator at Preston and Northcote Community Hospital in 1993 and from 1994 until 1997 he worked as Trauma and Surgical Critical Care Fellow and Attending Traumatology surgeon at the Hospital of the University of Pennsylvania, Philadelphia PA. In 1997 Dr McMahon took up his position as co-joint academic/senior staff specialist at the Canberra Hospital.

Dr McMahon was instrumental in establishing the Snowy SouthCare Helicopter retrieval service to service the region with medical and specialist support. He achieved recognition for the hospital as the first accredited Trauma Centre in Australia.

A/Prof Rachel Wei Li, MD, PhD. Laboratory Research Co-ordinator

A/Prof Li obtained a Bachelor of Medicine from China Medical University in 1982 and worked as a surgeon and senior infectious diseases specialist at China Medical University from 1982-1996. Her Master project was on immune responses to viral infection. She led a number of clinical trials in anti-viral and anti-inflammatory drugs and successfully transferred an intellectual property to pharmaceutical industry. In 2002 A/Prof Li completed her PhD in pharmacology at Southern Cross University and gained her post-doctoral research experience in molecular pharmacology in the University of Hawaii School of Medicine.

A/Prof Li returned to Australia in 2006 joining TORU and has established TORU laboratory with a focus on osteoimmunology. She has developed a range of laboratory capabilities to determine the effects of therapeutic, surgical and physio-therapeutic treatments on biomedical markers using human primary cell culture and large animal models.

In addition to her research work, she is an Adjunct Associate Professor at the University of Canberra teaching and supervising the students in Master of Pharmacy Program.
Dr Jennie Scarvell, PhD. Clinical Research Co-ordinator

B(App)Sc Physiotherapy (Sydney), Grad Cert Higher Ed, (Canberra) Cert Health Economics (Monash) PhD (Sydney).

Dr Scarvell’s research interests include many aspects of orthopaedics and rheumatology, particularly knee kinematics and medical imaging. A career as clinical physiotherapist lead Dr Scarvell to a PhD on knee kinematics and the role of aberrant motion in degenerative change using a model of ACL injury. Exciting projects currently in train include collaborations with UNSW@ADFA in 2D to 3D image registration for kinematic analysis and in measurement of wear in polyethylene.

Dr Scarvell was one of the inaugural Master of Physiotherapy program staff at the University of Canberra 2004-2007. She wrote and taught curriculum, and developed the clinical education program. Dr Scarvell is a registered physiotherapist and convener of the APA ACT Symposium. She is an adjunct Senior Lecturer at ANU and University of Canberra. Contact: jennie.scarvell@act.gov.au

Roxanne Miller B.Human Mvmt Sc. (Hons). Roxanne gained her degree from Southern Cross University in 2003. Her research was an investigation into colostrum supplementation in the elderly. Roxane manages the pelvic fractures database and joint implant retrievals. Contact: Roxanne.miller@act.gov.au

Jane Wilson BAppSc (hons). Jane has a background in Ross River virus pathology and viral arthritis, sports science and human physiology. Jane is conducting the Journey knee and the Stryker Triathlon knee projects. Contact: jane.wilson@act.gov.au

Mingming Chen BSc, PhD. Mingming is an NH&MRC scholar in osteoclast and osteoblast coculture at JCSMR and TCH labs.

Jin Dai BSc (Cellular and Molecular Biology), MBiotech, ANU. He has been a biological lab technical officer in Cytokine Molecular Biology and Signaling Group at John Curtin School of Medical Research, prior to joining TORU lab. He is currently working on wear particles, rheumatoid arthritis, and bone growth.

SiZhu Zhao BBioTech, MBioTech. SiZhu is an Mphil student of TORU. She gained her bachelor of biotechnology from China and Master of Biotechnology from ANU. SiZhu has a background in allergy and immunohistochemistry. She joined TORU this year and currently working on biomaterial projects.

Angela Fearon BAppSc(Physio), MPhysio. Angie completed her Bachelor of Physiotherapy at Lincoln Institute of Health Sciences and her Master’s degree in 2001. She has been a clinical Physiotherapist since 1986 and established her own practice in Canberra. Ms Fearon’s PhD thesis looks at tendinosis, enthesopathy and Greater Trochanteric Pain Syndrome. Contact: angie.fearon@anu.edu.au

Diana Perriman BAppSc(Physio), MSc. Diana attained her physiotherapy degree from Sydney University in 1982 and her Master’s degree at the University of East London (UK) in 1995. Her Masters research investigated the effect of orthotics on the hemiplegic ankle using electrogoniometry. Diana’s PhD thesis at ANU involves an investigation of kyphotic thoracic posture in normal adults and people with stroke. Diana is an NH&MRC Dora Lush Biomedical scholar. Contact: diana.perriman@anu.edu.au

Susannah Littleton M.Public Health, Cert. Critical care nursing, RN. Susannah has been a member of TORU through her work on the Accident Care Evaluation study, sponsored by the NRMA ACT Road Safety Trust. Susannah’s PhD program, explores clinical pathways for people with musculoskeletal injuries following road accidents. Contact:
susannah.littleton@acec.biz

Jonathon Slater BMedSc Jonathon has transferred from Monash to ANU for his MBBS/PhD study. His thesis looks at side curtain airbag deployment in side impact motor vehicle accidents.

Anil Nair, MBBS. Anil is an orthopaedic registrar at Canberra Hospital, and is completing his Master of Surgery at ANU in ankle fracture fixation.

Sivashankar Chandrasekaran,MBBS. M.Sports Med. Siva is undertaking a Master of Surgery at TORU through ANU, while an orthopaedic registrar at Canberra Hospital. His research is on PCL-injured knee kinematics.

Neha Pal Neha has just completed her honours thesis regarding the activation of polyethylene debris on dendritic cells at the ANU.

Kylie McKay is the Office Manager for TORU. Contact 02—6244 3858 Kylie.mckay@act.gov.au

Dr Jennie Scarvell, Clinical Research Coordinator
The responses of bone and immune cells to wear particles derived from prosthetics

The honours thesis of Ms Neha Pal was supervised by Rachel Li, and Paul Smith of TORU and Dr Ben Quah, of John Curtin School of Medical Research at ANU. To collaborate on this project has been tremendously worthwhile, and we appreciate Ben’s great contribution.

Genuine wear particles of polyethylene were generated by the prototype knee actuator in the knee simulator laboratory at UNSW @ ADFA.

Abstract: Aseptic loosening compromises the lifespan of prosthetic joint. It is a consequence of osteolysis or excessive degradation of the bone tissue surrounding artificial joint prostheses, leading to a loss of fixation and joint failure. Wear particles generated between the two articulating surfaces of the prosthesis have been implicated in driving this process of excessive bone degradation via an inflammatory response at the periprosthetic site. The characteristics of these wear particles, such as composition, shape and size are said to be critical determinants of the extent of the pathological response. Thus this study aimed to investigate the effect of various size fractions of ultra high molecular weight polyethylene (UHMWPE) on osteoblast (bone forming cells) viability, osteoblast function, in the induction of osteoclast (bone degrading cells) and finally the activation of dendritic cells. The results of this study demonstrate that size fractions of 0.05-0.2µM decreased osteoblast viability. The size fractions of 0.05-0.2, 0.2-0.8 µm and 0.8-1.0µM consistently decreased osteoblast cell function at the particle density in 1:100 (one cell :100 wear particles). At higher concentrations, wear particles were shown to induce dendritic cell activation.

All in all, there is some evidence to suggest that wear particles affect osteoblasts, osteoclasts and dendritic cells in a way to enhance osteolysis and thus promote aseptic loosening of the prosthesis.

Understanding the motion pattern (kinematics) of the joints whether normal, disease-effected, or following surgery, is integral to developing effective musculoskeletal treatment. The most accurate, and industry standard approach has been the use of roentgen stereophotogrammetry (RSA).

This involves implanting tantalum beads in the bones then taking X-rays through two imaging planes to generate a 3D model. The major limitation of RSA is the need to implant tantalum beads. This procedure is performed under general anaesthetic, so studies of pre-operative kinematics or healthy joints are rare. For example, despite the huge investment of resources in knee replacement design for perfect kinematics, there is no prospective study to assess how much of the post replacement kinematics is due to the pre-operative condition of the knee, and its pre-operative kinematics.

The alternative approach is to register 3D CT data with individual 2D video frames of the knee captured using single-plane x-ray fluoroscopy. The limitation of this method has been the huge computer power required to conduct the image registration, and development of the algorithms to do this.

Mark Pickering and Muhit Abdullah Al of Engineering and IT at UNSW@ADFA have teamed up with Jennie Scarvell and Tom Ward at the Trauma and Orthopaedic Research unit to use defence technology to make this possible. This year they have published two engineering papers and an orthopaedic paper (see publications).

UNSW will support this work in 2010 by a gold star grant recognising the international standing of this highly competitive research.

Fluoroscopy images and CT images are edge-enhanced, prior to matching frame by frame. The end product is a 3D dynamic model of knee motion.