# Paediatric Spine Research Group

# Newsletter - February 2017

*The QUT Paediatric Spine Research Group (PSRG) was formed in 2002 to conduct clinically driven, high quality research into spinal deformities and disorders.*

## Emeritus Professor Mark Pearcy honoured by Engineers Australia

At their annual Division Meeting last year, Engineers Australia inducted Professor Pearcy into their Hall of Fame. Since 2003, the Queensland division has inducted eminent engineers to honour those individuals who have made outstanding and lasting contributions to the engineering profession. Professor Pearcy was recognised for his contribution to Biomedical Engineering and the positive impact this has had in the community. His research and scientific publications on the mechanics of the spine are recognised internationally. Mark also led the team that sourced the funding, built and developed the Medical Engineering Research Facility that opened on the site of Prince Charles Hospital in 2008. He has been a committed member of Engineers Australia and a driving force behind the establishment of biomedical engineering education in Australia, particularly at the Queensland University of Technology.


Professor Mark Pearcy being presented his Hall of Fame induction certificate by the Qld Division President, Mr Chris Warnock.

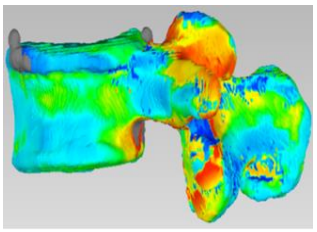
## Qld X-Ray Research Masters Candidates

Dr Colin Davis' Master's Thesis is currently under examination after completing his two years with the PSRG, thanks to the valuable support of Queensland X-Ray. He leaves us to continue his medical career. His project analysed the size, shape and angles of pedicles (ellipse-shaped regions of bone which connect each vertebral body with its posterior elements) in idiopathic scoliosis patients to provide clinically important information to surgeons regarding the placement of pedicle screws during scoliosis correction surgery as well as to clarify the natural history of pedicle deformation as scoliosis develops.

Our second Queensland X-Ray Masters candidate, Dr Prathmesh Contractor is now entering his second year. His work is focussing on the 'Longitudinal analysis of thoracic spine growth and deformity in the adolescent spine using sequential MRI scans'. He will analyse a group of healthy adolescent girls and compare their results to a similar group who have idiopathic scoliosis. His work will provide new understanding of how deformity occurs as the spine grows which may assist us to ultimately develop new treatments and preventative interventions to minimise deformity onset and progression in our teenagers.

## Congratulations! – Masters awarded November 2016

Jessica Benitez-Mendieta was awarded her Masters by Research recently for her work which involved the challenge of producing 3D spine models from MRI. Modern high resolution MRI has the advantage over CT scans of involving no radiation dose for the patient but it was the labour intensive and time consuming manual segmentation of MR images which Jessica's project addressed successfully & which is likely to be of great benefit to researchers worldwide in the future.



## Award - Spine Society Annual Scientific Meeting, Melbourne, 2016

The Spine Society meeting is the largest annual Australian multi-disciplinary spine conference. The PSRG was pleased to have given five podium & one poster presentation. This meeting is an opportunity to showcase our research as well as network with other clinicians and researchers. An added bonus in 2016 was the award received by our own Dr Geoff Askin for his presentation entitled, *"Maintenance of spine flexibility with the use of semi-constrained growing rods for early onset scoliosis in children."* The Alistair Robson Award was

for the most outstanding contribution by an independent clinician in clinical practice. The other PSRG presentations were:

1. *Perioperative complications associated with spinal fusion in Rett Syndrome.* ***Izatt,** Downs, Wong, **Askin,** McPhee, Cundy, Leonard.

2. *Changes in tissue diffusion and anisotropy following mechanical loading of ovine annulus fibrosus.* ***Little,** Tourell, Momot, **Pearcy.**

3. *Biomechanical analysis of growing rods used in the management of early onset scoliosis using a robotic testing facility.* ***Irvin, Brooker, Askin, Labrom, Pearcy, Grant, Adam.**

4. *Analysis of pedicle morphometry in adolescent scoliosis.* ***Davis, Grant, Pearcy, Askin, Labrom, Izatt, Adam, Little.**

5. *Segmental biomechanics after single & multi-level lumbar spine fusion.***Brooker, Pearcy, Irvin, Adam, Grant, Labrom, Askin, Little**

## SpineWeek 2016 – Singapore

Dr Nicolas Newell, Dr Paige Little and Dr Caroline Grant all presented their work at SpineWeek in Singapore, whose theme this year was *"Controversies in Spine Surgery"*. This meeting is a coming together of eighteen prestigious spine societies from all over the world for the purpose of education, research dissemination and innovation to provide a platform for the advancement of spine care. Dr Nic Newell was awarded the second prize for Best Poster presented at the meeting.

Dr Grant was shortlisted for the Best Podium presentation award for her work on spinal cord positioning in scoliosis patients. Authors: **Newell, Grant, Keenan, Izatt, Pearcy, Adam**. Title: *Sequentially quantifying progressive anterior overgrowth in the vertebrae of adolescent idiopathic scoliosis patients.*

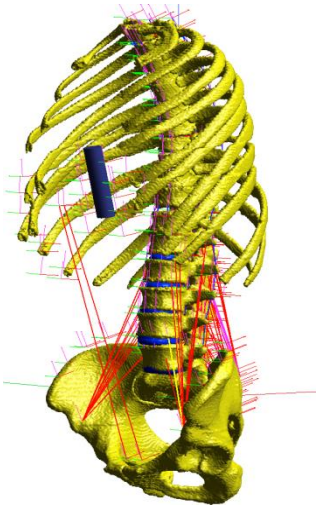
## Visiting UQ Medical Students shine!

As part of their studies, first year UQ medical students, Mr Luke Reynolds and Ms Caroline Yu approached the PSRG to spend their clinical placement time with us. Rather than 'observe' in a purely clinical setting for the required four weeks, these driven students requested a more involved placement with a research component and both have achieved the rewards of their initiative and work commitment. Ms Yu was one of only six medical students whose abstract was selected by a panel of Judges to be given as a podium presentation at the Australasian Student's Surgical Conference in Brisbane. Her presentation went on to win the Best Student Research Presentation and the resulting PSRG journal paper has been accepted for publication in SPINE (In Press). Authors: **Yu, Grant, Izatt, Labrom, Askin, Adam, Little**. Title: *Change in lung volume following thoracoscopic anterior spinal fusion surgery: a three-dimensional computed tomography investigation.*


Ms Caroline Yu giving her presentation of the ASSC in Brisbane

Mr Luke Reynolds also produced a journal paper from his project which is currently in the final stages of the international peer-review process. **Authors: Reynolds, Izatt, Huang, Labrom, Askin, Adam, Pearcy. Title:** *Is vertebral rotation maintained after thoracoscopic anterior scoliosis surgery? A low dose CT study.* We expect both to be published shortly. Congratulations Luke & Caroline.

## Partnership with Stuttgart Researchers



Above: Spine model showing newly incorporated muscles as red lines joining the pelvis and spine

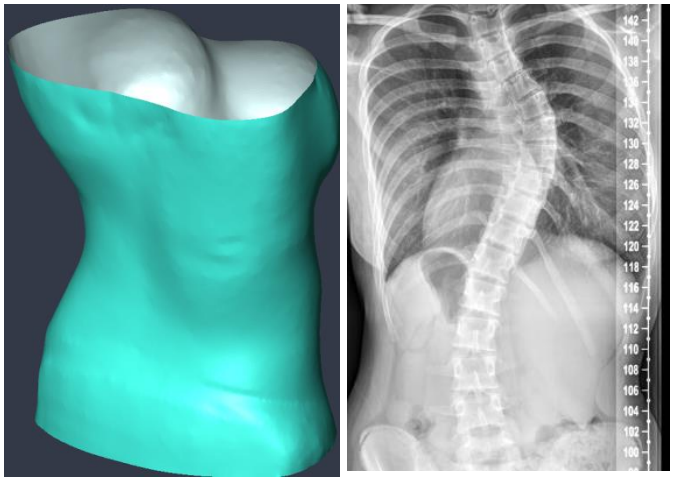
Dr Paige Little has continued to advance the PSRG's collaborative project with the Human Movement Simulation Laboratory at the University of Stuttgart to amalgamate our spine modelling capacity with their advanced muscular simulation software.

Jun-Prof. Syn Schmitt visited the PSRG in Brisbane for 2 weeks in May, during which time he worked with our researchers as well as taking time out to meet our local Australian fauna. During his visit, Jun-Prof. Schmitt was invited to present a Visitor Seminar at the Institute of Health and Biomedical Innovation at QUT. Following his visit, two

of his research students undertook a research placement with PSRG, spending a total of 3 months working with Dr Little to further the capabilities of the patient specific computational model. The first stage of muscle integration is completed with the lower spinal muscles implemented in our spine model, leading to the unique ability to predict the loads in the spinal tissues during daily activities.

## Aus Viz Conference, Sunshine Coast

The PSRG's Dr Caroline Grant was invited to present her work at the prestigious Aus Viz Conference at the end of 2016. This exciting event brought together computer software enthusiasts from all over Australia to showcase the current state of 3D visualisation and holograph technology. Dr Grant's work was received very enthusiastically due to its immediate and ongoing practical applications in the modern clinical setting. Her presentation was entitled *"3D surface scanners in the clinical setting – accuracy and application"*. (Authors: Grant CA, Johnston M, Adam CJ, Little JP). New technology now allows us to non-invasively map the external visible deformity seen in scoliosis as an additional tool to the standard scoliosis radiograph.

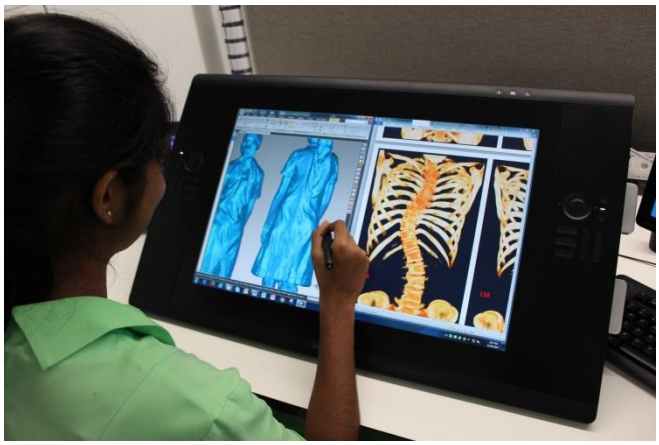


Surface scan (left) which captures skin surface and standard X-Ray (right)

This is done using a non-contact handheld 3D scanner which is capable of capturing high resolution 3D scans of the surface anatomy in the clinical setting in a matter of minutes.

## Fostering the next generation of Medical Researchers

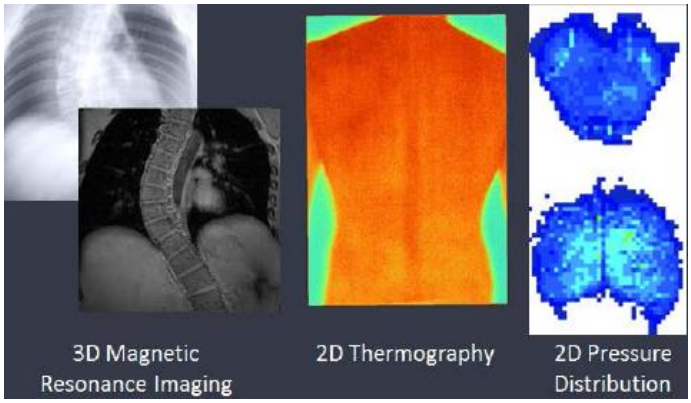
The new Centre for Children's Health Research being in very close proximity to Somerville House School provided the impetus to build a mutually beneficial relationship between the two. Research groups, including the PSRG, volunteered to accept teenage interns who would work closely with the researchers during their Years 10 and 11. The students themselves were put through a competitive process by the school for the opportunity to join the highly sought after programme. It is hoped the unique and innovative mentoring programme will allow the students to experience active medical research that directly impacts the care of Queensland children and inspires them to enter the STEM (Science Technology Engineering and Mathematics) fields of study at the University level.



One of the PSRG's Somerville House interns working on an imaging project after school in the Centre for Children's Health Research

## Grant Success – "MASSIVE"

Dr Caroline Grant successfully applied for a grant which allows PSRG researchers access to "MASSIVE", which is the Multi-modal Australian ScienceS Imaging & Visualisation Environment (two High Performance Computers with a total of 2224 CPU Cores!) from the National Computational Merit Scheme. The day a week access to MASSIVE is equivalent to a cost of $10,000. As such it will enable us to progress a project which aims to create a methodology to combine multiple imaging datasets into a single multi-dimensional analytical and visual space to establish the links between internal and external anatomy and physiology in the human body. Numerous imaging datasets (photos, CT scan, MRI scan, X-Ray, surface scanning, thermal photography etc.) will aim to be combined to enable the innovative analysis and visualisation of human systems, e.g. by mapping a 2D thermal image onto a 3D surface scan, and combining it with a 3D MRI, the correlation between skin surface temperature changes and the underlying muscle and vascular anatomy can be examined on screen.




Independent 2D and 3D medical imaging aim to be combined to create a 3D multi-modal visual and analytical model.

## PSRG Journal Publications in 2016-17

1. **Loch-Wilkinson T, Adam CJ, Izatt MT, Labrom RD, Askin GN, Pearcy MJ**. Morphometric analysis of the thoracic intervertebral foramen osseous anatomy in patients with adolescent idiopathic scoliosis using low dose CT. *Spine Deformity 2016 4(3): 182-92.*

2. **Little JP, Pearcy MJ, Izatt MT, Boom K, Labrom RD, Askin GN, Adam CJ.** Understanding how axial loads on the spine influence segmental biomechanics for idiopathic scoliosis patients: A magnetic resonance imaging study. *Clinical Biomechanics* 2016, 32:220-228.

3. Downs J, Torode I, Wong K, Ellaway C, Elliot EJ, Christodoulou J, Jacoby P, Thomson MR, **Izatt MT, Askin GN,** McPhee B, Bridge C, Cundy P, Leonard H. Surgical fusion of early onset severe scoliosis increases survival in Rett syndrome. *Developmental Medicine & Child Neurology 2016 58(6): 632-8.*

4. **Grant CA, Newell N, Izatt MT, Keenan BE, Askin GN, Labrom RD, Pearcy MJ**. A comparison of vertebral venous networks in adolescent idiopathic scoliosis patients and healthy controls. *Surgical & Radiologic Anatomy 2016 pp 1-11.*

5. **Newell N, Grant CA, Keenan BE, Izatt MT, Pearcy MJ, Adam CJ.** A comparison of four techniques to measure the anterior and posterior vertebral body heights and sagittal plane wedge angles in adolescent scoliosis. *Med Biol Eng Comput 2016 pp 1-12.*

6. **Grant CA, Izatt MT, Labrom RD, Askin GN**, Glatt V. Use of 3D printing in complex spinal surgery: historical perspectives, current usage and future directions. *Techniques in Orthopaedics 2016 31(3):172-80.*

7. Green N, Glatt V, Tetsworth K, Wilson LJ**, Grant CA**. A practical guide to image processing in the creation of 3D models for orthopaedics. *Techniques in Orthopaedics 2016 31(3):153-63.*

8. Ranger TA, **Newell N, Grant CA**, Barker PJ**, Pearcy MJ**. The role of the middle lumbar fascia on spinal mechanics: A human biomechanical assessment. *Spine 2016 ePub Aug.*

9. Lottering N, Alston-Knox CL, MacGregor DM**, Izatt MT, Grant CA, Adam CJ**, Gregory LS. Apophyseal ossification of the iliac crest in forensic age estimation: CT standards for modern Australian subadults. *Journal of Forensic Science 2016 ePub Nov.*

10. **Fairhurst H, Little JP, Adam CJ**. Intra-operative measurement of applied forces during anterior scoliosis correction. *Clinical Biomechanics 2016 40:68-73.*

11. Schouman T, Schmitt M, **Adam CJ**, Dubois G, Rouch P. Influence of the overall stiffness of a load-bearing porous titanium implant on bone ingrowth in critical-size mandibular bone defects in sheep. *Journal of the Mechanical Behavior of Biomedical Materials 2016 59; 484-496.*

12. Berger S, Hasler CC, **Grant CA,** Zheng G, Schumann S, Buchler P. A software program to measure the 3D length of the spine from radiographic images: Validation and reliability assessment for adolescent idiopathic scoliosis. *Computer Methods & Programs in Biomedicine 2017 138: 57-64.*

13. **Davis CM, Grant CA, Pearcy MJ, Askin GN, Labrom RD, Izatt MT, Adam CJ, Little JP**. Is there asymmetry between the concave and convex pedicles in Adolescent Idiopathic Scoliosis? CT investigation. *Clinical Orthopaedics & Related Research 2017 475(3):884-93.*

14. **Sewell MD**, Platinum J, **Askin GN, Labrom RD**, Hutton M, Chan D, Clarke A, Stokes OM, Molloy S, Tucker S, Lehovsky J. Do growing rods for idiopathic early onset scoliosis improve activity and participation for children? *Journal of Pediatrics 2017 ePub Dec.*

15. **Keenan BE, Izatt MT, Askin GN, Labrom RD,** Bennett DD, **Pearcy MJ, Adam CJ.** Sequential MRI reveals individual level deformities of vertebrae and discs in the growing scoliotic spine. *Spine Deformity 2017, accepted Oct 2016.*

16. **Yu CG, Grant CA, Izatt MT, Labrom RD, Askin GN, Adam CJ, Little JP.** Change in lung volume following thoracoscopic anterior spinal fusion surgery: a three-dimensional CT investigation. *Spine 2017, accepted Oct 2016.*

*17.* Tourell M, Kirkwood M, **Pearcy MJ**, Momot K, **Little JP**. Load-induced changes in the diffusion tensor of ovine annulus fibrosus: A pilot MRI study. *Journal of Magnetic Resonance Imaging 2017, accepted Sept 2016.*

18. **Little JP, Izatt MT, Adam CJ, Lofgren O, Sundberg A, Labrom RD, Askin GN.** Evaluating the Change in Axial Vertebral Rotation Following Thoracoscopic Anterior Scoliosis Surgery Using Low-Dose CT. *Spine Deformity, 2017, accepted Dec 2016.*

19. Newell N, **Little JP**, Christou A, Adams MA, **Adam CJ**, Masouros S. Biomechanics of the human intervertebral disc: A review of biological materials. *Journal of the Mechanical Behaviour of Biological Materials 2017, accepted Jan 2017.*

## Surface Scanning produces 3D computer models with good accuracy

PSRG research staff volunteered for 3D surface acquisitions using a simple hand held scanner which produces accurate 3D computer images in only a few minutes – see below. Images can be manipulated easily on the computer screen or can be printed as 3D models in any desired size.

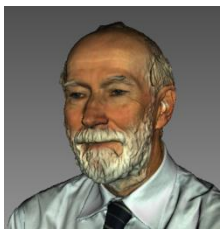

Dr Caroline Grant


Maree Izatt


Dr Paige Little


A/Prof Clayton Adam


Dr Colin Davis


Prof Mark Pearcy

## Thank you to our Supporters

The PSRG would like to acknowledge those who have generously supported us in many ways in 2016. Our sincere thanks to: Queensland University of Technology, Mater Foundation, Mater Magnetic Resonance Imaging Department, Queensland X-Ray, Children's Health Queensland, Medtronic Australasia Pty Ltd, Heidi Batson, Dr Robert Labrom, Dr Geoff Askin and Emeritus Professor Mark Pearcy.

Any questions or want to know more?
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