ICAAS-NLB series on
"Body Parts: The Science of Human Reconstruction"
February 2006

Part I, 4th February, 3-5pm.
Public Lecture

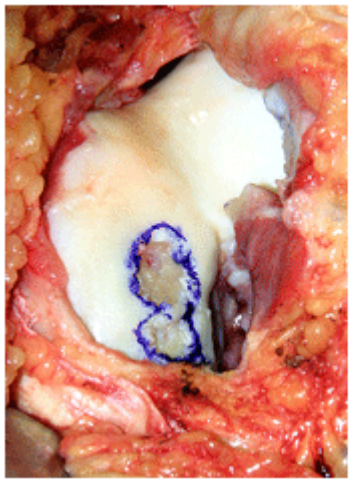
Contact: Prof. James Hui Hoi Po (doshuij@nus.edu.sg, 6772-4342)

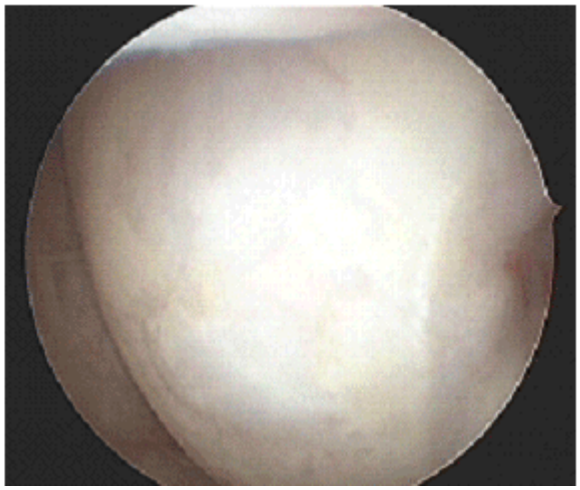
"Stem Cells in the Regeneration of Human Musculoskeletal System"

Abstract: The challenges to the practicing clinicians in the 21st centruy is the desire of our ageing patients to remain physically active and continue to contribute to society and younger patients who participate in demanding sports activities. The ability of Stem Cells to develop into a variety of specialised tissue holds infinite promise but bound with scientific and ethical controversies. The stem cells used in orthopaedic surgery are usually Mesenchymal Stem Cells (MSCs), harvested from the bone marrow, fat or periosteum of patients themselves, then cultured in the laboratory. Mesenchymal stem cells are more differentiated cells than embryonic stem cells but they still have the potential to develop into muscle, bone, cartilage and other tissues. Furthermore, they are the patient's own cells, without the concern for problems of rejection. Potential applications include the use of stem cells in:-

- Growth plate arrest in children
- Cartilage problems like wear and tear of the joints
- Anterior cruciate ligament (ACL) reconstruction
- Meniscus repair
- Development of artificial tissues like muscles and tendons

The pictures below depict the state of the knee in a patient with cartilage injury. The picture on the left demonstrates a cartilage defect in the knee joint. The picture on the right was taken in the same patient 6 months after procedure; the defect had filled in with new cartilage. In this lecture, the speaker would try to provide some understanding of the issues concerning stem research and its potential therapeutic uses in regenerating human musculoskeletal system.





Speaker: **Associate Professor James Hui**, MBBS(Sing), FRCS(Edin), FAMS(Sing), Senior Consultant, Department of Orthopaedic Surgery, National University Hospital and National University of Singapore. Professor Hui specializes in the management of orthopaedic problems in children and cartilage problems in adults. Professor Hui completed his medical degree at the National University of Singapore. He subsequently completed his surgical and orthopaedic training in UK and Australia. Professor hui is actively involved in undergraduate and postgraduate teaching at NUS and Academy of Medicine. He is actively involved in clinical and basic science research, especially in the clinical application of stem cells in the repair of cartilage, ligament, meniscus and growth plate. He is currently the Director of the Cartilage repair programme funded by National Health Group and Ministry of Health, as well as the Group Leader of Cartilage Division, National University Tissue Engineering Program.

Part II, 9th February, 7-9pm.
Workshop on Assistive Technologies

1/
Contact: Chia Woon Yee (chia_woon_yee@spd.org.sg, 6236-6354, director of technology), Tan Chuan Hoh (tan_chuan_hoh@spd.org.sg)

Short Presentation on "*Assistive Technology by The Society for the Physically Disabled*"

Abstract: The talk provides a general overview of Assistive Technology. Assistive Technology is a tool or application which enables people with disabilities to overcome their limitations. Audience will be shown some examples of assistive technology and how they are used. Specific focus of the talk will be on local assistive technology research and develop works and two projects will be showcased.

Speaker: **Tan Chuan Hoh**, Senior Occupational Therapist, The Specialised Assistive Technology Centre, The Society for the Physically Disabled

Showcase by the The Specialised Assistive Technology Centre, The Society for the Physically Disabled (SPD)

Enabled Cyber Games

The Enabled Cyber Games is a research project started by the Specialised Assistive Technology Centre (ATC). The project is made possible with seed money from Samsung and was launched at World Cyber Games Finals in November 2005.

The Enabled Cyber Games project looks into adapting special game controllers for people with physical disabilities so as to allow them to play computer games competitively. Audiences will have opportunities to try these special Xbox Game Controllers and play with disabled players.

The Specialised ATC is currently working on improving and adapting more game controllers for the World Cyber Games 2006.

TenGO Keyboard

The TenGO Keyboard Project is a research project between Xrgomics Pte Ltd and the Specialised ATC. The project was funded by the Social Enterprise Fund from the Ministry of Community Development, Youth and Sports.

The TenGO keyboard is a universally designed keyboard which works with a special software application – TenGO. TenGO shortens typing

process using word prediction and combinations of keys into 6 main categories. People with disabilities who have limitations in their hands are able to improve their typing speed by using the TenGO keyboard. TenGO is also available as onscreen keyboard. The TenGO is available for audiences to try at the exhibition.

2/

Contact: Dr. Guan Cuntai (ctguan@i2r.a-star.edu.sg)

Short Presentation on "*Let Brainwave Make Sense: Augmenting the Power of Communication and Control by Brain-Computer Interface*"

Abstract: Brain-computer interface (BCI) is a fast-growing emergent technology in which researchers aim to build a direct channel between the human brain and the computer. This technology provides a new alternative of augmentative communication and control for the physically disabled. There are two general approaches in building a BCI — invasive and non-invasive — the former provides more precise control but requires electrode implantation into the brain. Non-invasive BCIs may find wider application because of their greater convenience and safety. In this talk, we will introduce the state-of-the-art of non-invasive brain-computer interfaces. Having recognized the challenges and difficulties in BCI research, we will focus on the introduction of a BCI system, Brainy Communicator, developed by Institute for Infocomm Research and Society for the Physically Disabled, Singapore. Brainy Communicator is an assistive communication and control device. It provides a solution for people with complete loss of physical limb movement to access computers, for example, to type texts or control home appliances.

Speaker: **Dr. Guan Cuntai** is Lead Scientist and Manager of Pervasive Signal Processing Department at Institute for Infocomm Research (I^2R). He is also the head of Neural Signal Processing Lab. He obtained his Ph.D degree in Electrical and Electronic Engineering in 1993. He has many years of experiences in various academic, research and industrial organizations with positions of associate professor, visiting scientist, research manager and R&D director. His current research focuses on investigation and development of effective framework and statistical learning algorithms for the analysis and classification of brain

signals, at the theory, algorithm and application levels. He is interested in machine learning, pattern classification and signal processing. He is a Senior Member of IEEE. He served as a member of program-committees in various international conferences, and a reviewer of various international conferences and journals.

Showcase by Institute for Infocomm Research on Brain-Computer Interface for the application of assistive technology (spelling and control).

Part III, 18th February, 3-5pm.
Public Lecture

Contact: Prof. James Goh Cho Hong (dosgohj@nus.edu.sg, 6874-5259)

Presentation on *"These Legs Are Made For Walking …"*

Abstract: In the 1996 paralympic, the world witness Tony Volpentest, a bilateral amputee setting a world 100m record at 11.36 seconds, just 1.52 seconds behind Bailey's world record time on the same track three weeks ago. The potential of developing new products and techniques that will enhance the quality of amputees' lives are immense. In addition, these products and techniques will lead to lower healthcare cost and highly functional medical devices. It is no surprise that modern engineering methods applicable to other industries are used in the field of prosthetic devices and services. For example, how the wooden artificial limb of the 1950's is being transformed to a leg with flexible plastic socket, computer-controlled knee, carbon fibre shank and energy storing foot is certainly commendable. Advancement in computer technology also witnessed the introduction of CAD/CAM and rapid prototyping methods for prosthetic socket manufacturing, improving artificial limb function and amputee acceptance. However, the implementation of such methods in the prosthetic industry is still at its infancy since its foundation is based mainly on artisan techniques. The talk will address the challenges in prosthetic devices and clinical practice that will have to meet new economies, demands and standards in the near future. Two areas of technological advancement, computer and materials will influence the prosthetic industry significantly. There is a need for research in computer control prosthetic devices (foot, ankle and knee) that will provide physiological limb functions in order for patients to enjoy a higher quality of life. Development in new materials that possess good structural strength but light in weight and low in cost are needed to produce reliable prostheses both for the developed and non-industrialised nations.

Speaker: **Prof. James Goh Cho Hong** is Research Director, Department of Orthopaedic Surgery, National University of Singapore. He graduated with a BSc (Hons.) in 1978 in the field of Mechanical Engineering, University of Strathclyde. Subsequently, he was offered a scholarship to do his PhD in Bioengineering at the same university and that he completed in 1982.

Professionally, he is a Chartered Engineer with The Engineer Council, UK. He is also a Principal Fellow at IMRE, Adjunct Fellow, Defence Medical Research Institute. He sits on PSB's Medical Technology Standards Committee. He is actively involved in organising conferences such as the International Biomedical Engineering Conference held every two years in Singapore. Dr Goh is a member of the World Council on Biomechanics. He is a founding member and current Vice-President of the Biomedical Engineering Society, Singapore. He sits on the editorial board of Clinical Biomechanics, Gait and Posture, Journal of Musculoskeletal Research. His main research areas are as follows:

- Gait analysis
- Biomechanics of the musculoskeletal system
- Prosthetic & Orthotics
- Biomechanics of osteoporosis
- Fracture healing
- Orthopaedic implant design & development
- Tissue Engineering

Part IV, 23th February, 7-9pm.
Public Panel Discussion

Contact: Prof. Lee Eng Hin (dosleeeh@nus.edu.sg, 6772-4342), Prof. Lye Kin Mun (lyekm@i2r.a-star.edu.sg, 6874-2002), Prof. Edison Liu (lieu@gis.a-star.edu.sg, PA: Long chay Lan, longcl@gis.a-star.edu.sg, 6478-8007), Prof. Michael Raghunath (bierm@nus.edu.sg, 6874-7657)

"The Making of the Six-Million-Dollar Man"

The panel will discuss the possibilities, challenges, and issues in the making of enhanced human beings---e.g., thru artificial enhancements to human senses, bioengineering of body parts, etc.

GoH: **Minister of State Gan Kim Yong**

Panel Moderator: **Prof. Lee Eng Hin**. Head of Paediatric Orthopaedics, NUS; and Head of Orthopaedic Surgery, Kandang Kerbau Women's and Children Hospital.

Panelists: (1) **Prof. Lye Kin Mun**, Deputy Executive Director, Institute for Infocomm Research, A*STAR. (2) **Prof. Edison Liu**, Executive Director, Genome Institute of Singapore, A*STAR. (3) **Prof. Michael Raghunath**, Chairman, Graduate Programming in Bioengineering, NUS. (4) **Dr. Lim Bing**, Senior Group Leader, Genome Institute of Singapore, A*STAR.

Dr Lee Eng Hin is currently Professor of Orthopaedic Surgery, National University of Singapore. He did his undergraduate and postgraduate training in Canada. His main research areas are in Musculoskeletal Tissue Engineering and Paediatric Orthopaedics and Rehabilitation. Combining his interest in Paediatric Orthopaedics and Tissue Engineering, he was one of the first to study the use of mesenchymal stem cells in the repair of physeal defects in long bones of children. This work is now at the stage of clinical application. He has won international research awards twice in the area of tissue engineering and was recently invited to write an editorial on Stem Cells for the Journal of Paediatric Orthopaedics, the premier journal for paediatric orthopaedic surgeons. He was the Presidential Guest Speaker for the British Orthopaedic Association Meeting in September 2004, speaking on "Stem Cells in Orthopaedic

Research". He is currently the Program Leader of the NUS Tissue Engineering Program (NUSTEP).

Associate Professor Michael Raghunath MD PhD, is a physician scientist jointly appointed between the Division of Bioengineering (Faculty of Engineering) and the Department of Biochemistry (Yong Loo Lin School of Medicine) at the National University of Singapore. He is Deputy Head for Research & Enterprises of the Division of Bioengineering and Chair of the Graduate Programme in Bioengineering in the NUS Graduate School of Integrative Sciences & Engineering. Dr. Raghunath´s academic basic research experience currently spans more than 17 yrs during which he became an internationally distinguished scientist in the field of matrix biology (pathobiochemistry of collagens and elastic fibers) and skin biology (wound repair and cornification disorders). He was invited speaker at numerous occasions including prestigious international events such as the GRC on Elastin and Elastic Fibres 1997**;** Autumn Meeting of the British Connective Tissue Society 1997; 5th Internatl. Symposium on the Marfan Syndrome, Helsinki, 1998; Launchsymposium of the Swiss Tissue Repair Society, 1999; XIth International Congress of Histochemistry and Cytochemistry, York, 2000; Milupa Meeting for Paediatric Research, Zürich 2002. He has cochaired the 4th International Symposium on the Marfan Syndrome. Centennial Event, Davos, Switzerland, 1996 and is the technical chair of the ICBME 2005 in Singapore. Dr. Raghunath was trained in immunology (1988-1990; University of Heidelberg), matrix biology and wound healing (post doctoral fellow, University of Zurich, Switzerland, 1990-1995). His independent career started 1995 with a professorial qualification grant of the German National Science Foundation (DFG) at the University of Muenster where he completed his Habilitation in 1996 with work on elastic microfibrils of connective tissue and was appointed in 1997 private docent (lecturer) for Physiological Chemistry & Pathobiochemistry at the University of Muenster. After clinical training in dermatology from 1997-2000 in Muenster, Dr. Raghunath joined Dr. Suwelack Skin& Health Care AG, one of the biggest manufacturers of freeze-dried collagen matrices, as director of R&D. There he formed a R&D team that was able position the company in the biotechnology sector for medical devices for the wound care market. In 2002 Dr. Raghunath returned to the Dept.

of Dermatology, University Hospital Muenster, to continue with research on skin biology, and identified novel mutations in the serine protease inhibitor LEKTI in the Netherton syndrome. Dr. Raghunath has received several awards for his work on matrix and skin biology: Promotion Prize of the University of Muenster 1998, Marfan Research Prize 1998 of the Marfan Foundation Germany; Poster Prize 1997 of the Eur. Academy of Dermatology and Venereology; 1st European Club for Paediatric Burns Prize1996, Marfan-Passage of the Swiss Marfan Foundation Stiftung in 1995; Nestlé-Prize for Paediatric Research 1992.

Dr. Edison Liu was born in Hong Kong, China, and emigrated to the United States in 1957. He received his bachelor's degree (Phi Beta Kappa) in chemistry and psychology from Stanford University where he remained to complete his M.D. in 1978. This was followed by internship and residency in internal medicine at Washington University, St. Louis, and clinical cancer fellowships at Stanford University (Oncology), and at the University of California at San Francisco (Hematology). He then pursued post-doctoral studies in molecular oncogenesis at the University of California at San Francisco in the laboratory of Dr. J. Michael Bishop identifying transforming genes in human leukemic states. In 1987 when he joined the faculty of Medicine at the University of North Carolina at Chapel Hill. There, he developed programs in leukemia and breast cancer research centering on molecular epidemiology and cell signaling. At UNC, Dr. Liu held faculty appointments in medicine, biochemistry, epidemiology, and genetics, and was director of UNC's Specialized Program of Research Excellence (SPORE) in Breast Cancer. From 1993 until 1996, Dr. Liu was leader of the Breast Cancer Program at the Lineberger Comprehensive Cancer Center, and co-founder of the Breast Care Center at UNC. In 1995, he was appointed Chief of the Division of Medical Genetics, School of Medicine, UNC. In 1996, he joined the NCI as the Director of the Division of Clinical Sciences. In this capacity, he was responsible for the scientific and administrative direction for the intramural clinical research arm of the NCI comprised of over 100 principal investigators, 400 trainees, and 1,200 employees. In 2001, Dr. Liu assumed the position of Executive Director, Genome Institute of Singapore which is a flagship programme of the Biomedical Sciences Initiative of Singapore. At the GIS, he is building an international research institute of 250 individuals focused on integrating genomic sciences with cell and medical biology.

Professor Lye Kin Mun holds a PhD and a Bachelor's degree, all in Electrical Engineering from the University of Hawaii, Honolulu and University of Alberta, Canada respectively. Kin Mun is a professor in the Electrical Engineering Department in the National University of Singapore (NUS). He has a rich and varied background in communications technology R&D, working with government agencies and world-class R&D laboratories. Kin Mun was previously the Director of the Centre for Wireless Communications (CWC). Under his leadership, CWC grew to become an internationally recognised R&D organisation in leading-edge wireless communications technology. It was later renamed Institute for Communications Research (ICR) with extended R&D capabilities in optical communications.

Dr Bing Lim received his MD and FRCP in Internal Medicine from the University of Western Ontario. He then combined a specialty training in Hematology & Oncology with a PhD at the University of Toronto where he developed some of the first in-vitro colony assays for human stem cells. He went on to do post-doctoral work at Harvard Medical School in Stuart Orkin's laboratory, where he established conditions that enabled the first in-vivo long-term expression of retro-viral mediated gene-transfer of the immune-deficiency disease gene ADA into hematopoietic stem cells transplanted into murine animals.

He joined Beth Israel Deaconess Medical Center, HMS in 1988 where he initiated a research program to identify and characterize novel hematopoiesis-related genes, at the same time developing and incorporating the use of murine embryonic stem cells as an in-vitro model system for functional genomics. As a Scholar of the Leukemia Society of America (1993-1995) Dr Lim's work led to the discovery of several novel hematopoietic genes linked to human diseases. Dr Lim is presently Associate Professor of Medicine Harvard Medical School where he continues to lead research on haematological malignancies and autoimmune disorders.

In 2002 Dr Lim joined the Genome Institute of Singapore as Senior Group Leader for Stem Cell and Developmental Biology to lead a team in investigating the genomics of stem cell growth and differentiation and in tissue engineering. The team, made up of an international group of investigators, students and post doctoral fellows, is now at the forefront of innovative research that integrates advanced genomics technology with fundamental questions impacting on the application of stem cells in regenerative medicine. Dr Lim also plays an active role in fostering the expansion of the international net work of stem cell researchers and collaborative efforts between academia and industries and sits on several international research committees and review boards.