UNIVERSITY ORTHOPAEDICS & HAND JOURNAL

Inaugural & Commemorative Issue 2012

Celebrating 60 years of Excellence in Teaching, Research and Clinical Service for Orthopaedics and Hand Surgery

University Orthopaedics,
Hand & Reconstructive Microsurgery Cluster
National University Health System
Singapore
From its early beginnings in 1952, the Department of Orthopaedic Surgery at Singapore General Hospital played a dual role of teaching undergraduates and providing specialty clinical service. In 1961, Professor Gunn fine-tuned the undergraduate and postgraduate teaching programmes. He started the slide library collection which grew to become one of the largest in the world, with more than 150,000 slides, carefully managed by Dr Kong Ban Tze. In 1985, the Department moved into National University Hospital. We moved again in January 2008 to Tower Block as University Orthopaedics, Hand & Reconstructive Microsurgery Cluster (UOHC) under the newly re-organised National University Health System (NUHS).

In sixty years, the cluster has been transformed into a Regional and International Centre of Excellence for Orthopaedics and Hand Surgery providing teaching, clinical service and research.

UOHC is now a Centre of Excellence for Teaching for both undergraduate and postgraduate training programmes. Recently, the latter has been transformed into the NUHS Orthopaedic Surgery Residency Training Programme. This was launched in 2011 with our first intake of six residents.

The cluster now provides subspecialty clinical service by University Spine Centre and Divisions of Hip and Knee, Shoulder and Elbow, Sports Injury, Paediatric Orthopaedics, Musculoskeletal Trauma, Musculoskeletal Oncology as well as Foot and Ankle Surgery in addition to Hand Surgery provided by the Department of Hand and Reconstructive Microsurgery.

UOHC is also actively engaged in cutting edge translational research and the clinical applications of new technologies. It now provides six integral core research facilities/laboratories – cell and tissue culture, histology, biomechanics, motion analysis, bone densitometry and x-ray. Indeed, it has distinguished itself as a Centre of Excellence for Musculoskeletal Research, winning several local and international research prizes.

These commendable achievements would not have been possible without the support, commitment and dedication of our administrative, clinical and research staff. We are also fortunate to have received strong support over the past sixty years from the National University of Singapore.
UOHC now takes great pride in celebrating its 60th Anniversary to be held in conjunction with the 35th Annual Scientific Meeting of the Singapore Orthopaedic Association from 8 - 13 October 2012. For the first time, we are hosting the 2012 RWH Pho Lectureship, VK Pillay Lectureship and N Balachandran Professorship in Paediatric Orthopaedics simultaneously in the month of October to coincide with the annual SOA Conference. All three distinguished speakers (from USA), Professor Gary Poehling, Professor Franklin Sim and Professor Kaye Wilkins respectively will be delivering their Lectures in the SOA Conference itself. To mark this event, a Gala Dinner for the 60th Anniversary has been organised on 10 October 2012. We hope many of our alumni and distinguished visitors of the cluster will come and join us in this big event.

UOHC has also taken the opportunity to launch its own journal – the University Orthopaedics and Hand Journal. It will provide an important avenue for documenting and tracking our progress in the future. UOHJ is also the official publication of our residency training programme. I encourage all residents to contribute to this journal.

This Inaugural and 60th Anniversary Commemorative Issue of the journal serves not only to recognise our important history, but is also a tribute to the contributions made by our predecessors and colleagues.

We are confident that UOHC will continue to excel in the years to come.
I am happy to take this opportunity to congratulate the Department of Orthopaedic Surgery, NUS on its 60th anniversary. This milestone is doubly significant because it also marks the Singapore orthopaedic fraternity’s 60th year, as the University Department was the first orthopaedic department in Singapore.

Over the last 6 decades orthopaedic surgeons have been prominent in patient care, looking after Singaporeans of all ages, from infants to the very old to prevent disability and save life. Orthopaedic surgeons also have supported those with long-term disabilities and built up institutions for their optimal care. We have done well beyond Singapore, being in the forefront in the international orthopaedic community through research, publications and orthopaedic specialty organisations. We are a well established specialty group that continues to thrive. Let me call on orthopaedic surgeons now to give back to the society that nurtured you. Play a bigger role in the future of our country, not only for orthopaedic surgery, but in shaping the wider health care system for Singaporeans. Step out of your comfort zone and work through clinical leadership, advocacy and comradeship in medical organisations to champion education and training and to ensure that Singapore’s health care continues to be of high quality. Take up the challenge to stem what others see as the inevitable rise of health care costs and help make changes, if necessary, radical changes, to ensure that health care remains accessible and affordable for all Singaporeans.

I wish you all the best in your celebrations of this occasion.
Message by
Associate Professor Benjamin Ong Kian Chung,
Chief Executive, NUHS

It is with great pleasure that I am penning this message for the inaugural publication of the 1st University Orthopaedics and Hand Journal.

I believe it is fitting that this publication marks the 60th Anniversary of the formation of the Department of Orthopaedic Surgery, NUS. This very special milestone will be celebrated this year in October 2012 in conjunction with the Annual Scientific Meeting of the Singapore Orthopaedic Association.

Befitting an academically accomplished entity, this journal is to be the official publication for the University Orthopaedics, Hand and Reconstructive Microsurgery Cluster of the National University Hospital and will also be the publication for the UOHC Postgraduate Residency Training Programme. This inaugural and commemorative issue includes abstracts of top articles published by UOHC staff over the past 10 years (2001-2011), showcasing the development of academic orthopaedic surgery. This dovetails well with the chronology of the growth of the Department of Orthopaedic Surgery as well as a history of the Department of Hand and Reconstructive Microsurgery.

As the population in Singapore and much of developed Asia ages, we are already seeing the demand for orthopaedic surgical expertise increase both from age related degenerative conditions as well as the increased expectation of older individuals wanting to stay active and lead quality lives. Better imaging, new technology, devices, instruments, materials and bone substitutes, coupled with advances in imaging, navigation and robotics hold the promise of delivering such better outcomes. Moreover, the practice will be increasingly less invasive, more physiological and ambulatory. Older patients also bring the challenge of multiple co-morbidities and modern practice entails working in teams beyond procedures alone.

I am proud of the heritage of contributions our institution’s orthopaedic specialists have made to advances in all of the areas outlined above. This new journal will, doubtless, chronicle best practices and advances as best evidence guiding practice is discovered or confirmed. As we look back to the solid foundations built over these 6 decades, I feel confident that the future development of orthopaedic and hand surgery at our academic medical centre will be pivotal in shaping future practice in delivering excellence in health care!
On behalf of the Yong Loo Lin School of Medicine and the National University of Singapore, I would like to extend my heartiest congratulations to the University Orthopaedics, Hand and Reconstructive Microsurgery Cluster on the occasion of the 60th anniversary of the NUS Department of Orthopaedics. This is indeed a significant milestone worthy of a big celebration!

My heart swells with pride as I read the Department’s history. It is inspiring to follow the Department’s transformation over the last 60 years - from its modest beginnings in 1952 to its status today as a regional and international centre of excellence for orthopaedic services, teaching and research in Asia. My profound thanks to the founding members of the Department and the successive Heads of the Department, for the Department and the School would not be where it is today without each and every one of them and their pioneering contributions. While the accomplishments are the collective achievements of the team, it is the mark of great leaders to bring the strong team together and unleash its potential.

In conjunction with the 60th anniversary celebrations which will be held during the Annual Scientific Meeting of the Singapore Orthopaedic Association, the Department will be launching the inaugural and commemorative issue of its Orthopaedics and Hand Journal, the official publication for the University Orthopaedics, Hand and Reconstructive Microsurgery Cluster. This is indeed a big milestone for the Cluster with the journal serving as the official publication for the UOHC Postgraduate Residency Training Programme. The journal will also serve as a platform for clinical and basic research papers published by UOHC staff to be shared with a wider audience, particularly our young surgeons-in-training. To kickstart the inaugural issue, I am told that all UOHC staff will be contributing abstracts of their top three papers that have been published over the past 10 years. What a great way to teach and nurture our younger generation of doctors in training, and this will serve to inspire our younger generation of surgeons to aim for greater heights.

Once again, CONGRATULATIONS to Professor Wong Hee Kit, faculty and staff of the University Orthopaedics, Hand and Reconstructive Microsurgery Cluster! My very best wishes to the team and I have utmost confidence the Cluster will continue to grow from strength to strength!
The 60th year of the Department of Orthopaedic Surgery has been a particularly good one. The department has performed extremely well in its 3 missions: Clinical, Teaching and Research. On all the indicators measured by the hospital and those which reflect department, the department has done very well. Finally, with respect to patient satisfaction, it obtained a result of 78.5% which is far above the target of 70% for this year.

For teaching, the major initiative has been the Residency Program which is taking shape. It is a very exciting program that is bringing in top trainees. This program has the mission of giving the trainees a holistic education in the art of Orthopaedics, and not the business. It is well underway and looks all set to produce excellent and committed young Orthopaedic surgeons.

For research, the performance of the department over the past 5 years has been excellent. The total citations obtained by the department of Orthopaedic Surgery has been the second most of all the clinical departments in NUH. The average citation per paper of 11.58 is the highest of any clinical department. The average number of publications per staff is the third of all the clinical departments. This had been achieved in the context of a very busy clinical practice in the surgical department.

I would like to finish with a personal perspective, that of a medical officer who 20 years ago, passed through the department of Orthopaedic Surgery and then Hand Surgery. I worked with Prof Wong Hee Kit, Prof Robert Pho, Prof Satku, Prof Kumar and Mr Kour Anam Kueh. To me, the greatest testimony and legacy which the department has left me, is that not once can I ever say that I saw a surgery being done for the wrong indication.

Secondly, rounds always started at Ward 51, the subsidised ward. Not once did I ever see good care being denied to subsidised patients. This legacy has influenced me and my ideals and also influences the way I see how any department should function.

I congratulate the Department of Orthopaedic Surgery of the National University of Singapore on its 60th anniversary.
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**Professor J A P Cameron (1952 – 1955)**

Mr J A P Cameron was offered an appointment to the Chair of Orthopaedic Surgery, in Singapore in 1952 and became the first Professor of Orthopaedic Surgery in Singapore. Together with Dr Khong Ban Tze, he organised a comprehensive undergraduate teaching programme in Orthopaedic Surgery. For the first time, graduating medical students from the University of Malaya were equipped with sufficient knowledge to manage common orthopaedic problems such as childhood poliomyelitis, bone and joint infections including tuberculosis and musculoskeletal injuries which was becoming prevalent because of the increasing number of motor vehicles on the road. He also helped to build ancillary services necessary for the specialty of Orthopaedic Surgery. Among the services that he started was an Artificial Limb Centre to develop orthoses and prostheses for children and adults disabled by poliomyelitis and injuries.

**Professor Anders Karlen (1956 – 1961)**

In 1952, Dr Anders Karlen, a Swedish surgeon from Karolinska Institute, Stockholm, joined the Department of Orthopaedics as its Lecturer. After Professor Cameron resigned in 1955, Dr Karlen became the Acting Head of Department of Orthopaedic Surgery. In 1956, he was appointed to the Chair of Orthopaedic Surgery. He started a separate burns unit in 1958. This unit remained under the care of the University Department of Orthopaedic Surgery until the Department of Plastics and Reconstructive Surgery was formed in 1972.

**Professor Donald Gunn (1961 – 1967)**

Dr Donald Gunn joined the Department of Orthopaedic Surgery in 1956 as its Senior Lecturer. He succeeded Dr Karlen and was appointed to the Chair of Orthopaedic Surgery in 1961. Professor Gunn emphasized the importance of meticulous record keeping and built a collection of teaching slides - each one carefully labelled, catalogued and classified by one of the pioneer staff members of the Department, Dr Khong Ban Tze. The Orthopaedic Slide Library became one of the largest and most complete in the world with over 150,000 slides. This collection laid the foundation for an Orthopaedic textbook titled “Orthopaedic Surgery in South and East Asia” authored by him. He also established the first Research Laboratory for the Department in 1964. He made research one of the pillars of the Department. In 1964, he also started the first International Orthopaedic Conference in Singapore. To honour him as an academician, the SOA (Singapore Orthopaedic Association) conferred a prestigious annual named lectureship - the “Donald Gunn Lecture”
**Professor Vettivaloo Kandasamy Pillay (1967 – 1972)**

Dr V K Pillay succeeded Professor Donald Gunn in 1967 and was appointed to the Chair of Orthopaedic Surgery as its first Local Professor. He laid down the foundation for Postgraduate Programme in Orthopaedics. He was instrumental in getting the local Master of Medicine Surgery Degree recognised by the University of Liverpool as an equivalent to the Diploma of Royal College of Surgeons in United Kingdom. This enabled local surgeons with the degree of Master of Medicine Surgery to pursue the Master of Surgery Orthopaedic Degree in Liverpool. He was also instrumental to the formation of World Orthopaedic Concern, an organisation dedicated to improving the healthcare of patients with orthopaedic problems in poor countries. In particular, he was always keen on enhancing orthopaedic education and improving orthopaedic treatment for patients in Asia. He became one of the founding members of the World Orthopaedic Concern. This organization was established in Singapore in 1975 following an Orthopaedic Symposium held in Oxford, United Kingdom, in 1973.

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**Professor Pesi Bejonji Chacha (1972 – 1980)**

Dr Pesi Bejonji Chacha joined the University Department of Orthopaedic Surgery in November 1967 as its Lecturer. He was promoted to Full Professor in 1978. He was awarded the prestigious Arris and Gale Memorial Lectureship of the Royal College of Surgeons of England in 1979 – the first Asian to receive such an award. He laid down the foundation for Microvascular Surgery in the Department and established the Department’s reputation as an Orthopaedic Microsurgical Centre of Excellence. He started a Microvascular Surgical Training Programme where he and Professor RWH Pho pioneered microsurgical techniques. He developed a comprehensive Postgraduate Orthopaedic Teaching Programme that involved trainees from neighbouring countries. In 1996, during the 12th Symposium of International Society of Reconstructive Microsurgery held in Singapore, he was given an award for his contribution to the advancement of Reconstructive Microsurgery in Singapore and the region.

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**Professor Kamal Bose (1980 – 1998)**

Professor Kamal Bose joined the University Department of Orthopaedic Surgery in 1972 as its Lecturer. He succeeded Professor Chacha to the Chair of Orthopaedic Surgery in 1980. Professor Bose developed research to its fullest in the Department. He introduced animal experimentation research and started the Experimental Surgical Laboratory in 1982. In 1983, he introduced motion analysis research and biomechanical research by developing the Gait Laboratory and Biomechanics Laboratory in Singapore General Hospital. In 1986, these facilities were relocated to the National University of Singapore.
Professor Lee Eng Hin (1998-2001)

Professor Lee Eng Hin succeeded Professor Kamal Bose as Head of Department of Orthopaedic Surgery, National University of Singapore, in 1998. During his tenure, he nurtured an environment to facilitate teaching and research in the department. His standing as a clinician scientist of international repute has translated into a formidable research programme centred on musculoskeletal tissue engineering and paediatric orthopaedics and rehabilitation. He was the founding Director of NUSTEP, the NUS Tissue Engineering programme, leading the charge in this cutting edge area of the life sciences. In recognition of his outstanding achievements in research and excellent track record, he was awarded the University Outstanding Researcher Award in 2006. He was also awarded the National Outstanding Clinician Mentor Award and the NHG Lifetime Achievement Award in 2008.

Professor Kandiah Satkunanantham (2001-2004)

Professor K Satkunanantham was appointed as Head, Department of Orthopaedic Surgery, National University of Singapore in July 2001. He provided outstanding leadership in guiding the Department to a higher level of achievement in the areas of teaching, service and research. Under his supervision, the Department established two lectureships - the VK Pillay Lectureship and the RWH Pho Lectureship. He administered the orthopaedic undergraduate and postgraduate teaching by introducing a programme for continual assessment to direct learning. He was Vice Chairman of the National University Hospital Medical Board on Quality Assurance from 2000 to 2001. He was instrumental in elevating the already high standard of clinical care in National University Hospital. He is currently serving as the Director of Medical Services, Ministry of Health Singapore, a position he has held since 2004.

Professor Wong Hee Kit (2004 – current)

Professor Wong Hee Kit assumed the Headship of the Department in 2004. During his tenure, Prof Wong further developed the subspecialties to their current high level of differentiation into divisions based on regional orthopaedics and specialised areas like musculoskeletal oncology and sports injury. He was instrumental in establishing the University Spine Centre in 2008 and serves as the current Head. He also established and embedded outcome based health services research into each subspecialty division. With the formation of the National University Health System, bringing the Yong Loo Lin School of Medicine and the National University Hospital under the same governance, the department has been reorganized into the University Orthopaedics, Hand and Reconstructive Microsurgery Cluster with Professor Wong as Cluster Chair. Professor Wong is a renowned spine surgeon and an outstanding clinician. He was awarded the inaugural NUHS Master Clinician Award in 2011.
HEADS OF DEPARTMENT
HAND & RECONSTRUCTIVE MICRO SURGERY

Regarded as the ‘Father’ of Hand and Reconstructive Microsurgery in Singapore, Professor Pho performed the first thumb replantation in 1977. He established the Department of Hand and Reconstructive Microsurgery at the National University Hospital in 1991, and since then has been a mentor to two generations of hand surgeons in Singapore. An analytical and versatile surgeon, he is well known internationally for his expertise in the area of musculoskeletal oncology and the concept of biological limb reconstruction, in particular for live fibula transfer. He is a keen teacher, always encouraging trainees to be deeply analytical in clinical work as well as in reviewing literature, rather than someone simply quoting books and journals, which he famously calls ‘newscaster’.

Associate Professor Lim Beng Hai (2000-2004)

Associate Professor Lim Beng Hai joined the Department of Hand and Reconstructive Microsurgery, National University Hospital, as the Head of the Department in 2000. He completed his fellowship training at the Christine Kleinert Institute of Hand and Microsurgery in Louisville, USA. He is known for the development of the “Lim and Tsai, Six Strand Tendon Repair Technique”. An expert microsurgeon himself, he encouraged the use of the operating microscope amongst all trainees. He was responsible for setting up the Microsurgery Training Laboratory in the National University Hospital, that currently runs the Annual Microsurgery Training Course attended by local as well as international participants.
**Associate Professor Aymeric Lim Yu Tang (2005-2008)**

Professor Aymeric Lim took over the Headship of the Department of Hand and Reconstructive Microsurgery in 2005. He is an expert on brachial plexus and peripheral nerve injuries. He is internationally recognised for his landmark papers classifying muscles based on intramuscular innervation and the development of intramuscular nerve repair technique and split tendon transfer both of which were translated to clinical practice. He has mentored a number of hand surgeons during his term. He is currently the Chairman of Medical Board of the National University Hospital. He regularly leads humanitarian medical missions to remote and underprivileged regions of the world such as Vietnam, Afghanistan and Indonesia.

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**Dr. Peng Yeong Pin (2008-2012)**

Dr Peng Yeong Pin was the Head of Department of Hand and Reconstructive Microsurgery. He is fondly known for his calm and unassuming nature. He completed his Microsurgery Fellowship at Chang Gung Memorial Hospital Taiwan and at Christine Kleinert Institute of Hand and Microsurgery in Louisville, USA. He is also an expert microsurgeon known for his innovative reconstructive solutions to complex trauma and tumour cases. Dr Peng developed the IMed (Image Enhanced Database for the Musculoskeletal System), a database meant for the collection and storage of clinical data that is currently used in the Department. He was the key figure behind the design and the development of the Hand and Reconstructive Microsurgery Centre (HRMC) in NUH in 2011.

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**Dr. Alphonsus Chong Khin Sze (2012-present)**

Dr Alphonsus Chong was appointed as the Head of Department, Hand & Reconstructive Microsurgery, University Orthopaedics, Hand & Reconstructive Microsurgery Cluster, National University Hospital, on 1 August 2012.

Dr Chong completed his Hand Surgery training in 2004. This was followed by an ASTAR fellowship in translational research and hand surgery at Stanford University, USA from 2005 to 2007.

He has a particular interest in paediatric hand surgery, especially the reconstruction of congenital hand anomalies. Dr Chong is active in both clinical and translational research. His translational research interest is in flexor tendon and wound healing, and techniques to improve outcome following tendon injuries. Dr Chong is also active in the development of Hand Surgery in Singapore and the region. He is currently Chairman of the Specialist Training Committee for Hand Surgery in Singapore, and President of the Singapore Society for Hand Surgery. He has participated in several international trips to both teach hand surgery and provide humanitarian surgery.
HISTORY OF DEPARTMENT
ORTHOPAEDIC SURGERY
History
Department of Orthopaedic Surgery, National University of Singapore

Contributed by Professor K Satku and Associate Professor Aziz Nather

Introduction

Orthopaedic surgery did not gain specialty status in Singapore until the later half of the twentieth century. Orthopaedic problems such as poliomyelitis, bone and joint infections including tuberculosis of the spine and skeletal trauma were common entities even during the first half of the twentieth century but were managed by the general surgeons. In 1939, the Saint Andrew’s Orthopaedic Hospital was founded by a grant from the Viscount of Nuffield and generous Singaporeans for the treatment of bone and joint tuberculosis. Despite this, all orthopaedic work continued to be undertaken by general surgeons.

In 1951, the Council of the University of Malaya, (now the National University of Singapore) deemed it appropriate for orthopaedic surgery to be given added weightage in the undergraduate curriculum, granted it specialty status, and created a Chair in Orthopaedic Surgery. Provisions were also made for the formation of a clinical department of Orthopaedic Surgery in the Faculty of Medicine. This was to be located in Norris Block at the General Hospital, Singapore (now Singapore General Hospital) (Figure 1).

Mr JAP Cameron who was Consultant Orthopaedic Surgeon for the Federation of Malaya, in Kuala Lumpur, was offered appointment to the Chair in Orthopaedic Surgery. Mr Cameron was no stranger to the University of Malaya or the General Hospital, Singapore. In 1930 he had served as House Surgeon at the General Hospital. In 1939 he had served as Acting Clinical Professor of Surgery and in 1941 Acting Professor of Anatomy at the King Edward VII College of Medicine (later renamed the University of Malaya). During the war years he was interned. After the war he returned to the United Kingdom and obtained the Master of Orthopaedic Surgery degree from the University of Liverpool in 1947. He returned to Malaya in the same year, as Selangor State Surgeon.

Mr Cameron assumed the Chair in April 1952 and became the first Professor of Orthopaedic Surgery in Singapore. He began the first Department of Orthopaedic Surgery in Singapore with the dual duties of teaching orthopaedic surgery to undergraduates at the University of Malaya as well as providing specialty orthopaedic surgery service at the General Hospital, Singapore. The medical staff of the Department at inauguration comprised Dr Khong Ban Tze who was a tutor, one medical officer Dr DB Wilkinson and 3 house officers Dr VE d’ Rozario, Dr Wong Mook Ow and Dr Ho Guan Lim. Later that year Dr Anders Karlen, a Swede from the Karolinska Institute in Stockholm, with Korean war experience, joined the department as Lecturer. That year, 1952, heralded the start of 50 years of development and astounding progress in orthopaedic surgery at the University of Malaya (now National University of Singapore).

Figure 1. The Department at Norris Block
Professor Cameron together with Dr Khong Ban Tze and, later, Dr Anders Karlen organised a comprehensive undergraduate teaching programme in orthopaedic surgery (Figure 2). For the first time, graduating medical students from the University of Malaya were equipped with sufficient knowledge to manage common orthopaedic problems such as childhood poliomyelitis, bone and joint infection (including tuberculosis) and bone and joint injuries - which were now becoming more prevalent because of the increasing number of motor vehicles on the road.

Professor Cameron also helped build ancillary services necessary for the specialty of orthopaedic surgery. Among the services that he started was an Artificial Limb Centre that was set up adjacent to the Norris Block building to develop orthoses and prostheses for children and adults disabled by poliomyelitis and injuries. The department was also given the responsibility for the management of patients with burns at the General Hospital.

Professor Cameron resigned in 1955 and returned to the United Kingdom(6).

Dr Karlen then acted as Head of the Department until February 1956 when he was appointed to the Chair in Orthopaedics(6). He started a separate Burns Unit in 1958. This unit remained under the care of the University Department of Orthopaedic Surgery until the Department of Plastic and Reconstructive Surgery was formed in 1972 at the Hospital(7).

In 1956 Dr Donald Gunn, who was to play a major role in the Department of Orthopaedics here, joined the Department as a Senior Lecturer(6).

In 1958 the first three Singaporean orthopaedic trainees, WGS Fung, KH Yeoh and VK Pillay joined the University Department. Having passed the Part I Australasian Fellowship examination, they proceeded to the United Kingdom in 1959 to complete Part II of the Diploma examination of the Fellowship of the Royal College of Surgeons. They then took a further year to train in Liverpool for the MCh Orthopaedic degree(1).

In 1959 a second orthopaedic department, a government unit, was established under the headship of Mr DWC Gawne to meet the increasing demand for specialised care in orthopaedics(8). The two departments worked together, sharing many facilities including the operating theatres at Norris Block. The University Department was called ‘C’ Unit and the Government Department ‘O’ Unit.

In January 1961, Professor Karlen retired and Dr Donald Gunn succeeded him(9). Professor Gunn was a great teacher and an academician who organised and fine-tuned the undergraduate as well as postgraduate teaching and training. He insisted on meticulous record keeping and started building up a collection of teaching slides which, over the years, ran into thousands, each one carefully labelled, catalogued and classified by one of the pioneer staff members of the department, Dr Kong Ban Tze. Two other persons who contributed with their tireless efforts were the department photographer, Mr Tow Siang Hong (who served from 1958 to 1994) and senior laboratory technician Mr S Sathiamoorthy (from 1958 to 2001). This orthopaedic slide library was acclaimed as one of the largest and most complete in the world, in excess of 150,000 slides. This collection laid the foundation for the orthopaedic textbook titled “Orthopaedic Surgery in South and East Asia” authored by Professor Gunn(10).

Professor Gunn also established the first research laboratory for the Department in 1964. Research has since been one of the pillars of the Department.
Drs WGS Fung, KH Yeoh and VK Pillay returned from the United Kingdom in December 1961 as the first local orthopaedic surgeons and joined the other pioneers in building and upgrading the orthopaedic services in Singapore(1). Drs Pillay and Yeoh joined the University Department as Lecturers while Dr Fung joined the Government Unit. Subsequently Dr PCN Wong (a New Zealander) joined the University unit.

When Professor Gunn resigned and left for the United States in August 1967, Dr VK Pillay was appointed to the Chair as the first local Professor of Orthopaedic Surgery(11). In the same year Dr Gawne retired and Dr WGS Fung became the first Singaporean Head of the Government Orthopaedic Unit(7).

During the tenure of Professor Pillay, the foundation for the postgraduate programme in orthopaedics was laid. Professor Pillay was instrumental in getting the local Master of Medicine (Surgery) degree recognized by the University of Liverpool as an equivalent to the diploma of the Royal College of Surgeons in the United Kingdom. This enabled local surgeons with the Master of Medicine (Surgery) degree to pursue the MCh Orthopaedic degree at Liverpool.

Professor Pillay, Dr Yeoh and Dr Cheng resigned from the University Department in 1972 and left for private practice. Dr Pesi Chacha who had joined the Department in November 1967 as Lecturer and who now was Senior Lecturer, became the Head of the Department. Dr Chacha was subsequently promoted to Associate Professor in 1973 and to full Professor in 1978.

The foundations for the Department’s reputation as an orthopaedic microsurgical centre of excellence were laid during Professor Chacha’s tenure. He started a microvascular training / teaching programme where he, Professor RWH Pho and others pioneered microsurgical techniques. The programme was made possible through the generous donations of Robin Shipyard, Lion’s Club East and Shaw Foundation. During Professor Chacha’s tenure, the Department also gained a reputation as a comprehensive postgraduate teaching department and welcomed trainees from neighbouring countries. The programme continues to this day and is supported by the University, the National University Hospital, Lee Foundation, Shaw Foundation and allied medical industries.

Professor Chacha resigned in July 1980 and was succeeded by Associate Professor Kamal Bose.

When the new Singapore General Hospital was opened in 1982 the Department moved into the new hospital from Norris Block. In 1985, with the commissioning of the National University Hospital, the University Department moved out of the Singapore General Hospital to the National University Hospital but continued to retain a presence at the Singapore General Hospital. This “C” unit was run by Professor RWH Pho until 1988, when all University staff moved to the National University Hospital. The ‘C’ unit was then taken over by Singapore General Hospital. The two units ‘C’ and ‘O’ have since merged and there is now a single orthopaedic department at the Singapore General Hospital.

At the National University Hospital, the Department staff also managed the clinical orthopaedic department at the Hospital, the Head of the University Department also assuming the post of Chief of the clinical department.

In 1990 three of our staff members, Professor RWH Pho, Associate Professor VP Kumar and Associate Professor K Satku and Dr A K Kour helped set up the Department of Hand and Reconstructive Microsurgery at the National University Hospital. Professor Pho was appointed Chief of the Department and remained its Chief till 2000. After having helped set up the Department, Professor Satku and Professor Kumar returned to the National University Hospital, orthopaedic department in 1999 and 2000 respectively.

In 2000 one of our staff, Associate Professor Lim Beng Hai, was appointed Chief of the Department of Hand & Reconstructive Microsurgery.

During Professor Bose’s tenure more research facilities were added. The Experimental Surgical Laboratory was started in 1982 and in the following year 1983, the Gait Laboratory and Biomechanics Laboratory were started. These were initially located at the Singapore General Hospital campus. In 1986 they were moved to the current location at Kent Ridge campus. Professor Bose continued as the Head of Orthopaedic Department until June 1998.
Professor EH Lee was appointed Head in July 1998. During Professor Lee’s tenure tissue engineering initiatives were started. Currently tissue engineering constitutes a significant portion of the Department’s research activities. In 2001 Professor Lee was appointed Dean of the Medical Faculty at the National University of Singapore.

In July 2001 Professor K Satku was appointed Head of the Department of Orthopaedic Surgery, National University of Singapore. He was succeeded by Professor Wong Hee Kit in April 2004.

Established in January 2008, the National University Health System (NUHS) combines the National University Hospital and the National University of Singapore’s Yong Loo Lin School of Medicine and Faculty of Dentistry under a common governance structure to create synergies to advance its tripartite mission of excellence in clinical care, translational clinical research and education. Professor Tan Chorh Chuan was appointed as its first Chief Executive. He was succeeded by Associate Professor Benjamin Ong in December 2008. Under this new organisation, the University Orthopaedics, Hand & Reconstructive Microsurgery Cluster (UOHC) was formed in 2008. It combines the Department of Orthopaedic Surgery and the Department of Hand and Reconstructive Microsurgery as one cluster.

The Department of Orthopaedics has, from its very modest beginnings with two academic teaching staff and four other clinical staff, been transformed in sixty years into a regional and international centre of excellence for teaching, clinical service and research. We have, today, 12 academic teaching staff (NUS), 13 other clinical staff (NUHS), 2 academic research staff (NUS), and 13 secretarial staff (6 NUS, 7 UOHC). For research, the Department is also supported by 8 laboratory staff and 6 research fellows (employed on grants). For clinical work, the Department is complemented by 10 clinical fellows yearly. These fellows are orthopaedic and hand surgeons from around the world with clinical attachment with the Department for a period of 6 months each. In addition, the Department of Hand and Reconstructive Microsurgery now has 3 academic teaching staff (NUS), 7 other clinical staff (NUHS) and 2 secretarial staff (UOHC).

Figure 3 outlines the development of leadership in the Department of Orthopaedic Surgery, National University of Singapore from 1952 to 2012. Also indicated in the figure are the other staff members of the department. The period during which these staff members were attached to the department is indicated in parenthesis.
<table>
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<tr>
<th>Yrs</th>
<th>At NUH (Chief)</th>
<th>At SGH (Head)</th>
<th>OTHER STAFF MEMBERS</th>
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<td>NUH HRM</td>
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<td>1952</td>
<td>JAP Cameron</td>
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<td>1956</td>
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<td>WGS Fung (1958); KH Yeoh (1958-1972); VK Pillay (1958-1972)</td>
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<td>1959</td>
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<td>1961</td>
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<td>PCN Wong (1961)</td>
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<td>K Satku (1975-present)</td>
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<td>Lee Eng Hin (1983-present); Wong Hee Kit (1983-present)</td>
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<td>James Hui Ho Po (1999-present)</td>
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<td>Alphonsus Chong Kin Sze (2011-present)</td>
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<td>Tan Ken Jin (2012-present)</td>
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</table>

NUH – National University Hospital
HRM – Hand and Reconstructive Microsurgery
University – National University of Singapore (Before 1980 - University of Singapore; Before 1962 – University of Malaya)
SGH – Singapore General Hospital (Before 1975 - Outram Road General Hospital; Before 1968 - General Hospital, Singapore)

Figure 3. Leadership and Academic Staff At The Department of Orthopaedic Surgery, NUS (1952 -2012)

Undergraduate Teaching Programme
The commitment of our staff to undergraduate teaching has ensured that the teaching programme evolved with the times. Newer pedagogical techniques for enhancing the educational experience have constantly been incorporated into the programme. The course duration and content have also been regularly updated to keep them relevant. It is with pride that we report that this programme remains one of the more popular clinical postings at our Medical Faculty.

In 1952 there were only two academic staff members responsible for the programme that spanned three weeks. Twenty eight students were enrolled in the programme and it was undertaken at the Department which was at the General Hospital, Singapore. The programme evolved to one spanning eleven weeks some ten years later. In 1996, this was re-structured into two parts – one spanning eight weeks in the third or fourth year and one lasting two weeks in the final year (revision posting). In 2007, the undergraduate teaching programme has been further restructured into three postings. The student population has also expanded. We teach about 250 students for Year 3 as well as 260 students for final year. Year 3 students are taught Orthopaedics over an
eight-week posting. Final year students are taught Revision Orthopaedics in a two-week posting. In addition, about 150 final year students are also attached to our Student Internship Programme for a period of four weeks (optional). Here, the students work on the job as student house officers supervised by our house officers.

The number of teachers participating in the programme has also grown. There is now 32 departmental teaching staff (13 NUS, 19 NUHS). In addition, the Department is complemented by more than 100 clinical teachers and tutors. The clinical resources made available for student teaching have also been expanded. Teaching is undertaken at the orthopaedic departments of the five main restructured hospitals i.e. National University Hospital, Singapore General Hospital, Changi General Hospital, Tan Tock Seng Hospital and Alexandra Hospital.

In 2001 when a former president of the American Academy of Orthopaedic Surgeons and a vice-president of the American Academy of Family Physicians wrote an article “It’s Past Time to Reform the Musculoskeletal Curriculum” we assessed our programme and noted that the Department was already well placed(15).

Clinical Services
During the early years of the Department the practice consisted largely of general orthopaedic surgery. This included the management of musculoskeletal trauma, bone and joint infections and the management of children with deformities from either poliomyelitis or congenital anomalies. The small number of orthopaedic surgeons in the early years precluded commitment to any particular subspecialty. With an increasing number of orthopaedic surgeons interest in subspecialties grew. It was only in the early 1980s that subspecialties began to gel. Today the Department offers expertise in the following subspecialties and has formed the University Spine Centre and Divisions of:-

- Hip and Knee Surgery
- Shoulder and Elbow Surgery
- Paediatric Orthopaedics
- Musculoskeletal Trauma
- Musculoskeletal Oncology
- Foot and Ankle Surgery

Research in Orthopaedic Surgery
The Department has been committed to research from its beginnings. Initially, although the research was largely clinical in nature, the setting up of a research laboratory during the tenure of Professor Gunn, as Head of Department, led to an increasing amount of basic science research being undertaken by the Department staff.

UOHC is now actively engaged in cutting edge research that encompasses basic science research, translational research and the clinical applications of new technologies.

It has now developed 6 different integral core research facilities/laboratories that specialize in cell and tissue culture, tissue histology, musculoskeletal biomechanics, motion analysis, bone densitometry and x-ray facilities. It has distinguished itself in the field of musculoskeletal research, winning a number of local and international research prizes.

The Cluster was also instrumental in setting up the University-wide NUS Tissue Engineering Programme (NUSTEP). Other research activities include the development of scaffolds and bioactive materials for clinical applications. It aims to develop novel orthopaedic implants and grafts with enhanced biological activities and host interactions. These research projects have received recent funding including Bioengineering Programme (BEP) Grants from A*STAR.

Our staff members are actively involved in the training of postgraduate students - the supervision of Ph.D and M.Sc. students.

Indeed, the Department is now well positioned to be a Centre of Excellence for musculoskeletal research.
Training the Orthopaedic Surgeon

Since the time of Professor Gunn, the Department has taken a keen interest in training the next generation of orthopaedic surgeons both for the Department and Nation. The MCh orthopaedic degree from Liverpool was the hallmark of the early pioneering surgeons in the Department and our local pioneering staff all had this degree. As the colonial influence waned and local expertise in orthopaedic surgery increased, the newer staff members undertook their training locally following the diploma of one of the Royal Colleges of Surgeons of United Kingdom. The local training was coupled with a year spent abroad in a well known and established institution in the United Kingdom, Canada or the United States to consolidate their training and interest in a subspecialty. They were awarded the Fellowship of the Academy of Medicine, Singapore, in Orthopaedic Surgery - FAMS (Orthopaedic Surgery) - to denote completion of specialty training in orthopaedic surgery.

UOHC has now launched the NUHS Orthopaedic Surgery Residency Training Programme in 2011 with its first intake of 6 residents.

The programme has been designed to produce residents with all the necessary skills and knowledge to produce orthopaedic surgeons who are not only technically competent but also show compassion and good ethical standards to produce the highest quality of patient care to all patients coming to National University Health System. They will not only be knowledgeable in the literature of orthopaedic surgery but will also be active in basic and clinical research to pursue novel methods of treatment including the latest technologies for improved patient care.

The residency programme has a span of 6 years of which the middle 4 years will be the Accreditation Council for Graduate Medical Education-International (ACGME-I) accredited years.

Conclusion

UOHC has grown to become a Centre of Excellence in the field of Orthopaedics and Hand Surgery locally and internationally. It now provides excellent undergraduate and postgraduate education (with the new residency training programme) and a tertiary clinical service (with nine sub-specialties). It has also gained recognition as a centre for translational research and the clinical applications of new technologies, having won several research prizes locally and internationally.

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HISTORY OF DEPARTMENT
HAND & RECONSTRUCTIVE MICRO SURGERY
The specialty of hand surgery has always been an integral part of the University Department of Orthopaedic Surgery since it was formed on the 1st of April 1952, at the General Hospital (GH), Singapore. The first local orthopaedic surgeon to show an interest in this sub-specialty was Dr Yeoh Kean Hong, who on his way back to Singapore in 1961, after completing his MCh, (Ortho) degree from the University of Liverpool, spent a short period with Paul W Brand in Vellore, India. Professor Donald R Gunn, then Chairman of Orthopedic Surgery, together with Dr Yeoh and Dr Raja Ayathurai, were closely involved in the initial growth of the specialty in Singapore. They performed surgical restoration of hand deformities in leprous cases with quite a large number of tendon transplants done at the Sungei Buloh Leprosarium.

With progressive industrialisation in Singapore in the 1960s and 1970s, the importance of the management of hand injuries became prominent. Dr Pesi B Chacha, who joined the University Department of Orthopaedic Surgery in 1967, was responsible for setting-up special clinics for hand surgery cases to handle the expected influx of hand trauma. Dr Kanwaljit Soin was the first surgeon to receive a Colombo Plan Fellowship to be trained in Hand Surgery. She worked in Australia with John T Hueston at the Plastic and Facio-Maxillary Surgery Unit of the Royal Melbourne Hospital in 1972.

In 1975, The University of Singapore, received a generous donation of S$40,000 from Robin Loh of Robin Shipyard through the Lions Club East of Singapore to establish microvascular surgery in Singapore. This marked a new chapter in the development of Hand Surgery in Singapore. In 1974, Dr Robert W H Pho, who was trained in Orthopaedics and Hand Surgery in the United Kingdom, joined the University Unit. Together with Dr Jimmy Daruwalla, Dr Yeo Khee Quan, Dr Tay Chong Kam and Dr Ong Leong Boon, and under the leadership and far-sighted vision of Professor P B Chacha, they launched an energetic move to set-up a microsurgical section within the University Unit of Orthopaedic Surgery. In 1976, the first re plantation service in this region was set-up. This provided the team with the impetus to push the frontiers of microsurgery in the management of hand injuries, limb salvage and reconstructive orthopaedic surgery to its highest level. In 1977 and 1978, it was possible to establish a fully operational microsurgical team, working closely with Government Unit, particularly with Dr Tan Ser Kiat who had a shown a keen interest in the field, and Dr Lee Seng Teik of the Plastic Surgery Unit.

The Hand Surgery Unit was officially established at the Singapore General Hospital (SGH) on the 1st of January 1985. The unit began with a small complement of staff, with Professor Robert W H Pho as Head and Senior Consultant, Mr Tan Ser Kiat as Consultant, and Mr Tan Kok Chai as Registrar. The team of nurses was headed by Nursing Officer Tay Kim Neo. The Hand Therapy team comprised of Ms Angeline Tang and Mrs Josephine Yip. In 1989, Mr Teoh Lam Chuan took over as Head of the Unit with the move of the University staff to the National University Hospital.
While infrastructure development in hand surgery was being developed, there was concurrent development in clinical services. The first upper limb replantation was achieved by Dr Leong Hin Seng and his team at the Alexandra Hospital on 12 April 1975. Drs Robert Pho, Tay Chong Kam and Yeo Khee Quan performed the first successful replantation of a completely amputated thumb on 21 January 1977. The first toe to hand transfer was carried out on 17 October 1980 by Drs Robert Pho, Tong G On, J S Daruwalla, Tay Boon Keng and Tay Chong Kam. The first free vascularised fibular graft transfer to the radius was done on 22 June 1978 by Drs Robert W H Pho, P B Chacha and K Q Yeo.

Professor Robert Pho and his team set out to establish a Hand division within the discipline of orthopaedic surgery at the National University Hospital (NUH) to complement the hand service at SGH. A new independent Department of Hand and Reconstructive Microsurgery was officially established at NUH on 1st December 1990 (Figure 1). This initially included staff that were seconded from the Department of Orthopaedic Surgery, NUS. The team comprised of Professor Robert Pho as Chief, Assoc Prof K Satkunanathan and Assoc Prof V P Kumar as Consultants, and Mr Kour Anam Kueh as Senior Lecturer/Senior Registrar. Professor Pho continued to develop and refine techniques of hand surgery, reconstructive microsurgery and limb salvage surgery in musculoskeletal oncology, while Dr Kour introduced the techniques of deformity correction and distraction osteogenesis. Dr John Chia, who received his fellowship training at the Indiana Hand Centre, started performing wrist arthroscopies on his return, further developing wrist surgery as a subspecialty field.

Professor Pho was succeeded as Chief in 2000 by Associate Professor Lim Beng Hai, who joined the department from Singapore General Hospital. Associate Professor Lim set up the Microsurgery Skills Training Laboratory, and began running regular training courses in basic and advanced microsurgery. This allowed trainee surgeons from Singapore and the region to be introduced to microsurgery, and also allowed trained surgeons to refine and improve their skills in the laboratory setting.

Associate Professor Aymeric Lim Yu Tang took over as Chief in 2004, during a trying period for the department due to the departure of several senior staff. Despite this, clinical services were further expanded through the establishment of a combined limb trauma service, together with the Division of Trauma in the Department of Orthopaedic Surgery. Patients with severe extremity trauma were co-managed upon admission to hospital, with early fixation and flap coverage done, resulting in lower infection rates and hospital stays for patients.
Dr Peng Yeong Pin was appointed as Chief in 2008 when Associate Professor Lim was appointed as the Chairman of the Medical Board of the hospital. He conceptualized, planned and created the Hand and Reconstructive Microsurgery Center - the largest, one-stop centre for hand surgery in the region, which was officially opened in April 2011 (Figure 2). The centre brought together staff from the Department of Hand and Reconstructive Microsurgery, Hand Occupational Therapists and a team of dedicated nursing and administrative staff led by Nurse Manager Hayati Bte Wahab.

![Figure 2. Inauguration of Hand and Reconstructive Microsurgery Center](image)

The Department of Hand and Reconstructive Microsurgery has contributed significantly towards research and development of Hand Surgery and reconstructive microsurgery, especially in the fields of replantation, free tissue transfers for reconstruction of the upper limb, refinement in the techniques of muscle and tendon transfer and in the field of hand prosthetics. We have also had the privilege of having worked with and trained many fellows from the region and beyond, who have since returned to start and advance these fields in their respective home countries. Many aspiring surgeons also continue to come and receive training at the Microsurgery Skills Laboratory. Currently, in addition to the treatment of degenerative, nerve, neoplastic and sports related conditions of the hand and wrist, the department provides 24-hour microvascular service for upper limb and lower limb trauma, as well as for the hospital liver transplant programme. It is hoped that continued research in the fields of tissue engineering and biomaterials will allow us to contribute to and shape the future of hand surgery in the world.

References:

HISTORY
RECENT DEVELOPMENTS
**September 2004 - Inaugural VK Pillay Lectureship**

The VK Pillay Lectureship was established to honour Dr V K Pillay, the department’s first local professor, for his extensive contributions not only to the University, but also to the orthopaedic fraternity in Singapore, regionally and internationally. The inaugural VK Pillay Lectureship was held from 26th September to 2nd October 2004. The first VK Pillay lecturer invited to speak at this event was Professor Surya Bhan, Head of Orthopaedics, the All India Institute of Medical Sciences, New Delhi, India.

**August 2005 – Inaugural RWH Pho Lectureship**

The RWH Pho Lectureship was established to honour Emeritus Professor Robert WH Pho, an eminent orthopaedic surgeon who has contributed extensively to the development of Hand and Microsurgery, not only in Singapore but also internationally. The inaugural RWH Pho Lecture was delivered by Professor Peter Stern, Chairman of Department of Orthopaedic Surgery, University of Cincinatti on 22 August 2005.
August 2007 – Launch of N Balachandran Professorship in Paediatric Orthopaedics
The N Balachandran Professorship in Paediatric Orthopaedics was launched on 24 August 2007 with a gift of $1,500,000 from Mrs Rita Balachandran, widow of Professor N Balachandran. The professorship is named in memory of the late Professor Balachandran who devoted 35 years of his working life in Orthopaedic Surgery and was instrumental in shaping and developing the practice of Orthopaedics in Singapore to what it is today. The professorship will be awarded annually to eminent international experts to further develop Singapore’s capability in the field of Paediatric Orthopaedics. Professor Stuart Weinstein, the Ignacio V. Ponseti Professor of Orthopaedic Surgery at the Department of Orthopaedics and Rehabilitation, The University of Iowa gave the inaugural lecture during the Singapore Orthopaedic Association Annual General Meeting in November 2008.

January 2008 – The beginning of University Orthopaedics, Hand & Reconstructive Microsurgery
In January 2008, the National University Health System (NUHS) was established. It combined the National University Hospital and the National University of Singapore’s Yong Loo Lin School of Medicine and Faculty of Dentistry under a common governance structure to create synergies to advance its tripartite mission of excellence in clinical care, translational clinical research and education. Professor Tan Chorh Chuan was appointed as its first Chief Executive. Under this new organisation, the University Orthopaedics, Hand & Reconstructive Microsurgery Cluster was formed. It combines the Department of Orthopaedic Surgery and the Department of Hand and Reconstructive Microsurgery as one cluster with Professor Wong Hee Kit as Cluster Chair.

June 2008 – Opening of University Spine Centre
The University Spine Centre provides patients a one-stop centre offering advanced clinical facilities and a patient-centric integrated process flow to treat different spinal problems. The University Spine Centre also systematically tracks clinical outcomes for efficient benchmarking, while providing a safe and personalised outpatient service.
June 2010 – The move to NUHS Tower Block
In June 2010, we shifted to our new office premises in NUHS Tower Block on Level 11. It was a massive exercise as our department has been in Level 3 of the main building of NUH since 1985.

Time to say goodbye. A final group photo along the corridor of the old office in Level 3, NUH.

First cluster board meeting on 18 June 2010 in NUHS Tower Block

March 2011- Opening of Hand & Reconstructive Microsurgery Centre
The Department of Hand & Reconstructive Microsurgery, National University Hospital consolidated their clinical services at the new Hand & Reconstructive Microsurgery Centre. New services such as fluoroscopic assessment of bone and joints of the hand and wrist as well as ambulatory surgery will be performed as a dedicated procedure room with state of the art facilities. Together with Hand Therapy and Hand Prosthetics, the Centre provides a one-stop Hand Surgery hub where comprehensive and streamlined care can be delivered to patients.

Opening of Hand & Reconstructive Microsurgery Centre on 14 March 2011 by AProf Joe Sim, Chief Executive Officer of NUH
PROFESSORSHIP/LECTURESHP
**Synopsis of Lecture**

Limb salvage surgery began in earnest in the seventies. Prior to this, amputations were considered the norm for limb sarcomas. The technologies involved in limb salvage went through a period of trial and error before its conversion from the art it was to the science it is now with few areas of controversy with relation to proper sitting of care. The stage is therefore set for the next leap, the next paradigm.

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**About the Speaker**

In 1980, Professor S M Kumta relocated from Pune, India to take up a position, initially as Visiting Lecturer, in the Department of Orthopaedics & Traumatology of the Chinese University of Hong Kong. His training and residency experiences in India were considered valuable assets. He found himself happily accepted and integrated into the department. He was initially under the Hand and Reconstructive Microsurgical Unit and subsequently joined the Musculoskeletal Oncology Division of the Department.

He is an accomplished and well-respected Musculoskeletal Oncology Clinician Scientist with a rare aptitude in both clinical (e.g. navigation in Musculoskeletal Oncology) and basic science (e.g. Molecular Regulation of Giant Cells) research.

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**Feedback on Lectureship**

It was indeed a pleasant surprise and really an honour to be asked whether I would accept the Prof. Robert Pho Lectureship for 2011.

Asked? I could not believe it -- such a distinguished honour! I accepted it without hesitation and of course with deep sincerity and humility. Not only because Professor Pho has been a mentor to many of us who have worked in the field of Hand and Reconstructive Surgery, as well as his fearless sense of enquiry and razor sharp clinical sense, but also because I felt so deeply drawn to the fraternity of one of the most respected and well known of academic units anywhere in the world.

The Orthopaedics and Hand Surgery Unit of NUH and its dynamic people are no strangers to me. I have seen the unit grow in excellence - with so many clinicians and academics with whom I had the great honour of interacting with at numerous academic meetings and exchange visits. The Professor Pho Lectureship would give me yet another opportunity to participate in academic dialogues with some of the brightest and most sincere minds anywhere in the world.

As with any top quality visiting exchange - the lectureship began with a packed day of talks and presentations, from my side as well as from academic consultants and senior residents at the NUH. The academic discussions and presentations covered not only the state-of-the-art practice in Musculoskeletal Surgery and Reconstruction but also highlighted the common problems faced by surgeons practicing complex oncological surgery. The case discussions were extremely engaging and I found that the residents and staff were very honest and
sincere when they presented some of the problems and difficulties associated with complex oncological
decision making. It was a pleasure to once again witness Professor Pho on home turf and at his very best
challenging, enquiring, stimulating and passing on the wisdom accumulated over the years. Indeed it was also
wonderful to see how leadership has been transferred to younger staff and how this has enabled the unit to
forge ahead and open up new frontiers in research.

Half a day in the weekend was reserved for a wonderful cycling tour on Pulau Ubin. This was a remarkable
experience, as it brought back an enchanting and rustic sense of nostalgia, remembering this island paradise of
the early eighties! The hard work of the previous days was followed up by a hectic ride around the island after
which I was treated to a superb feast of seafood along with the local beer and the spicy Singapore chilli crab!!

The research day was extremely well organized. It was heartening to see such close multidisciplinary cooperation
developing into cutting edge translational research. I was very much impressed with the doctoral and master
students who presented their work with such confidence that can only come with a sense of commitment and
a depth of understanding. FULL marks to their supervisors!!

During the day I was also given a formal introduction to the department and its rich founding heritage. My hands
were shaking as I signed the Department’s guest book as it contained the Who’s Who of the orthopaedic world.
I really felt humbled and extremely honoured to have been given the opportunity to participate in the lectureship
programme!

The lectureship culminated in the Prof Pho Lecture, in which I revisited a topic of which Professor Pho has
been a pioneer and a champion. My talk touched upon the changing paradigm of Limb Salvage Surgery, with
particular reference to patient specific custom prosthetic reconstructions and the extended limb salvage that
is now possible with Navigation-Aided Surgery. The lecture was extremely well attended and I saw many old
friends - people who have made a lasting impression in Orthopedic Surgery not only in Singapore but all over
the world.

I was deeply touched by my visit. The informal evening with Professor Pho gave us a chance to understand the
grace of living life beyond the world of the academic, of deeper meanings to what we do and why we do so. I
felt a wonderful sense of warmth and camaraderie with the people who have made this unit happen- with old
and good friends such as Hee Kit (Wong) – who has been our examiner, Suresh (Nathan) and Aziz (Nather),
Mark (Puhaindran) and so many others (too many names to add).

Having been through a few other similar programs I can simply say that this was the very best I have ever been
to. I learnt a lot - believe me. It was time to leave and the excellent hosts made sure I was comfortably escorted,
with personal touch and a flair beyond the ordinary.

I shall continue to have fond memories of this visit and wish the Lectureship and the Orthopaedics Unit at NUH
the very best for years and years to come.
2011 N Balachandran Professorship in Paediatric Orthopaedics
LECTURE: What it means to be a Surgeon

13th October 2011

Synopsis of Lecture

This lecture is a philosophical review of the nature of surgery and its practice. The surgeon as Captain of the Ship will be defined. The management of complications is an important part of the surgeon’s experience, and techniques for patient discussions will be discussed.

About the Speaker

Dr. Tony Herring has been the Chief of Staff at Texas Scottish Rite Hospital for Children since 1978. He is the third physician in the history of the hospital to serve in this position. Dr. Herring is a Phi Beta Kappa Graduate of The University of Texas at Austin and an Honour Graduate of Baylor University College of Medicine. He completed his internship in Straight Medicine at Peter Bent Brigham Hospital in Boston and a surgical research fellowship at Harvard University. Dr. Herring also completed his junior residency in Surgery and his residency in Orthopaedic Surgery in the Harvard Combined Orthopaedic Residency Program. He completed the Berg Sloat Travelling Fellowship in 1975. He is a professor in the Department of Orthopaedic Surgery at The University of Texas Southwestern Medical Center at Dallas and is an Associate Staff Member at the Children’s Medical Center, Dallas and Consulting Physician at Parkland Memorial Hospital. Dr. Herring has served as Chairman of the Pediatric Committee of the American Academy of Orthopaedic Surgeons and President of the Pediatric Orthopaedic Society of North America. He is an Associate Editor for the Journal of the American Academy of Orthopaedic Surgeons.

Feedback on Professorship

The Balachandran Professorship Lecture was an excellent forum. I spoke on 3 topics, Legg Perthes disease, My Experiences in Film Making, and What it means to be a Surgeon. I was especially impressed with the excellent hands-on surgical laboratory and teaching during the professorship. The enthusiasm of the teachers was shared by the eagerness of the surgeons in attendance. All the educational and social activities were beautifully planned and carried out. For me, the many participants from the wide variety of countries and the many conditions discussed were especially important. I felt that our teaching efforts were going out to surgeons who would definitely benefit from their participation. I again would like to thank the hosts and sponsors of this excellent meeting.
2011 V K Pillay Lectureship
Lecture: How Basic Science and Clinical Studies Change Our Perception of Lumbar Disc Disease

Synopsis of Lecture

Recent basic science studies on discogenic low back pain have provided new knowledge about this condition. The speaker will review some of these results and present an overview of the following findings. The rat lumbar intervertebral disc may be innervated non-segmentally through the paravertebral sympathetic nerve and segmentally through the sinuvertebral nerves, and also by dichotomizing sensory fibers. The exposure of the nucleus pulposus (NP) to the outer annulus fibrosus (AF) may induce nerve injury and ingrowth into the disc. Nerve growth factor (NGF)-sensitive neurons are predominant in the rat intervertebral disc, which indicates that hyperalgesic responses can be induced by inflammation. NGF in the NP may promote axonal growth. Lumbar fusion may inhibit nerve ingrowth into the degenerative disc and reduce the percentage of Calcitonin Gene Related Peptide (CGRP)-positive neuron.

About the Speaker

Professor Kazuhisa Takahashi has been the Chairman of the Department of Orthopaedic Surgery, Graduate School of Medicine, Chiba University since 2007. He was also the Vice-Dean, School of Medicine, Chiba University and the Vice-Director of Chiba University Hospital from 2009 through 2011. He also holds some key positions in spine academia and research, such as Vice-Chairman for the ‘The Japanese Society for Spine Surgery and Related Research’. In addition, he is the Second Vice-President of ‘The International Society for the Study of the Lumbar Spine’. Professor Takahashi is also a reviewer for various journals in spinal surgery, which include the 'Spine'.

He has received many awards for his scientific contributions, the main one being 2005 ISSLS (International Society for the Study of the Lumbar Spine) Prize. He has authored over 200 scientific publications and has written 8 book chapters. His research interest is in lumbar disc disease and lumbar spinal stenosis.

Feedback on Lectureship

I enjoyed the academic programme very much during my stay in Singapore.

I was very impressed by the well-organised clinical and basic research systems in Singapore. I am confident that Singapore will be a new leader in medical science. In this sense, we, Japanese, would like to maintain good collaboration with you.
Synopsis of Lecture

The American healthcare system is undergoing tumultuous changes. These changes are necessary to overcome the growing healthcare expenditure and at the same time, maintaining or even improving the quality of the healthcare system. Assessing the quality of healthcare is difficult. Unlike other industries, such as the automobile industry where the process to mass produce certain products has been refined over years of practice, the healthcare environment is extremely complex due to differing patient and system issues that hamper the consistent quality efforts. A variety of quality measures are being instituted in the US that are based on process measures, such as preoperative delivery of antibiotics and venous thromboembolism prophylaxis. However, with the rather complex healthcare environment in the US consisting of multiple payer systems, instituting these measures is challenging. Defining what constitutes adequate quality measures, is also an evolving target.

However, despite these difficulties, measuring quality in healthcare is moving at a rapid pace in the US and will be adopted in other nations once these efforts have been shown to improve healthcare while controlling escalation of cost. These efforts are certainly worthwhile endeavors that continue to challenge the physicians and surgeons who must track the changing environment of delivering care to patients.

About the Speaker

Professor Kevin C. Chung MD, MS, the Charles B. G. De Nancrede (Chair of the Department of Surgery at University of Michigan, 1847-1921) Professor of Surgery, received his health services research training as a Robert Wood Johnson Clinical Scholar from the University of Michigan. He obtained his general surgery training from the University of Texas in San Antonio, his Plastic Surgery training from the University of Michigan and his Hand Surgery training from the Curtis National Hand Center in Baltimore.

Dr Chung is Director for the American Board of Plastic Surgery and the American Board of Surgery. He serves as a member of the Plastic Surgery Residency Review Committee. He is the Vice-President for Research for the American Society for Plastic Surgeons and Plastic Surgery Foundation. He has been a Council Member for the American Society for Surgery of the Hand. He has published over 260 peer-reviewed manuscripts, over 150 book chapters, and 12 textbooks. Dr Chung is a National Institute of Health funded researcher and the principal investigator of an R01 grant for a multicenter clinical study on the Rheumatoid Hand that has received a competitive renewal and another R01 grant on a clinical trial for the treatment of Distal Radius Fracture in the elderly.
Dr Chung has also received a K24 Midcareer Investigator Grant in Patient-Oriented Research, a R34 Clinical Trial Planning Grant and a R21 Exploratory/Developmental Research Grant Award from the National Institute of Health. He is the first recipient of the Weiland Medal from the American Society for Surgery of the Hand to honour a Hand Surgeon whose research work advances the specialty. He is the 2011 Researcher of the Year for the American Association of Plastic Surgeons. Dr Chung is the Deputy Editor for the Journal of Hand Surgery and is the Outcomes Section Editor for Plastic and Reconstructive Surgery.

Feedback on Lectureship

It was a well structured academic program.

There was a well coordinated social program. The get-together in the evening was highly enjoyable and showed the much valued Singapore hospitality.

This is an outstanding faculty with excellent clinical offerings. If there is a facet that can be in the immediate long-term plan for the NUS, it is to develop a distinctive surgeon-scientist track in which the faculty will have protected time to perform cutting edge clinical and basic science research. This will position NUS in the national arena by constant production of high quality publication, not just case series of surgical techniques, but creative papers based on innovative research methodology. We have an 850-member physician-scientist track at University of Michigan in which I am in charge of as the Dean. The faculty in this track continues to showcase the prestige of University of Michigan by consistently publishing in the top journal of their respective disciplines.
Synopsis of Lecture

Great advances have been made in producing joint replacements that clearly improve function in adults. Similar advances have been made in childhood. However, Paediatric Orthopaedics has been a rather conservative field and only recently has it been suggested that joint realignment and re-shaping procedures be performed for moderate joint and limb deformities to prolong joint durability and function. Current epidemiologic data suggests that children born in the year 2000 are likely to live to age 90 years and beyond. The number of adults reaching 100 years of age is skyrocketing each year. Accordingly, we should assess our intervention in Children’s Musculoskeletal Conditions with a goal of maintaining the child’s own biologic tissues for a lifelong journey. The role of the Orthopaedic Surgeon in this new model for decision making provides special challenges.

About the Speaker

Dr. Dennis Wenger is a Board Certified Orthopedic Surgeon and fellowship trained in Pediatric Orthopedics. He earned his medical degree from the University of Cincinnati College of Medicine and completed a surgery internship at the Denver General Hospital. He completed his postgraduate training with an orthopedic residency at the University of Iowa Hospital and his Pediatric Orthopedic Fellowship at The Hospital for Sick Children in Toronto, Canada. While at the University of Cincinnati, he was awarded the Alpha Omega Alpha Medical Honorary, and he was given the Bert-Sloat Traveling Fellowship of the Orthopedic Research and Education Foundation.

Dr. Wenger’s clinical interests are scoliosis, foot disorders in children, hip disorders, cerebral palsy, spina bifida and fractures. He is recognized for clinical and research work concerning surgical treatment of scoliosis, as well as other spine deformities in children, and hip disorders. He has authored more than 90 scientific papers in medical journals, 13 book chapters and several textbooks on Pediatric Orthopedics.

Feedback on Professorship

It was a privilege and honor for me to have been invited to be the 2010 N Balachandran Professor for the Singapore Orthopaedic Association. I had been to Singapore previously, but it was a special honor to be invited to speak as an eponymous lecturer. I was happy to find that this was not simply a children’s orthopedic meeting, but in fact was a combined meeting with the orthopedic nations of Southeast Asia. The academic breadth of topics presented and the visiting professors from all the specialties of Orthopedic Surgery who came there from throughout the world made the program particularly educational.
The Children’s Orthopedic session was very well attended and I appreciated the attention given to all of the Children’s Orthopedic papers, and in particular my N Balachandran Professorship Lecture, which was entitled ‘Will Your Child Live to be 100? Children’s Orthopedic Methods to Optimize Hip and Lower Limb Function’.

I also appreciated that the academic program was not just limited to the hotel where the meeting was given, but also included the possibility to visit the National University Healthcare System (NUHS), including the offices of Professor Wong Hee Kit, as well as the many other professors in the Orthopedic Department, including James Hui. The hands-on bio-skills laboratory session, which was carried out at the NUHS was of special value, and allowed me to understand the depth of commitment to surgical teaching that occurs in Singapore. Having this session as part of the overall program added special value, since I was able to demonstrate techniques that we have learned in Children’s Orthopedics in San Diego. Overall, this was an outstanding academic program with great breadth and a great variety of material being presented.

The academic program was matched with an excellent social program, including a private dinner with the leading Orthopedic Professors in Singapore, as well as Mrs. Balachandran who came to the meeting from North America to present the N Balachandran Award to me for giving the lecture. This special dinner was held in a quaint, very British type of private club, which gave me a very good sense of Singapore’s history. Other social events were very well organized and included a boat ride on the Singapore River to a nice restaurant near the bay, as well as to a seafood restaurant on the small island at the southern edge of the city.

My wife Kathy had never been to Singapore and was happy to travel with me on this trip. This was a very special privilege for her, and I recommend that you encourage Visiting Professors to bring their wives to these international conferences whenever possible.

In summary, the combination of an excellent academic program, the sense of vibrancy of the entire Singapore City-State, and an outstanding social program, made my N Balachandran Visiting Professorship to Singapore one of the highlights of my academic career.
Synopsis of Lecture

Wear particle induced periprosthetic osteolysis is a clinical problem for long surviving total joint replacements. New developments in bearing surface technology include Vitamin E infused highly cross-linked surfaces. This lecture will review the science and development of these new bearing surfaces and also show early clinical data from patients with cementless hip replacement.

About the Speaker

Dr. Andrew Freiberg is the current Arthroplasty Service Chief at Massachusetts General Hospital and an Associate Professor of Orthopaedic Surgery at Harvard Medical School. His education and training include an undergraduate degree from Northwestern University followed by medical school at the University of Cincinnati College of Medicine. He then completed General Surgery and Orthopedic training at the University of Michigan Hospitals in Ann Arbor, Michigan. Dr. Freiberg also completed an Adult Reconstructive Surgery Fellowship at Massachusetts General Hospital (MGH).

His clinical and research interests include Minimally Invasive Hip and Knee Arthroplasty, Partial Knee Replacement, and Complex Revision Surgery. The research programme at MGH has a long interest in the development and study of new bearing surfaces that can be used in Arthroplasty. Dr. Freiberg is an internationally recognized Orthopaedic Surgeon specializing in Minimally Invasive Hip and Knee Replacement and Partial (Unicondylar) Knee Replacement. He is also an expert in Complex Hip and Knee Revision Arthroplasties and fracture treatment.

Feedback on Lectureship

I was thrilled to be the VK Pillay Lecturer and was truly honored to have the opportunity to visit the National University Hospital and participate in the academic program. It was wonderful to meet and give a lecture to the residents and medical students. In addition, the warmth and hospitality of Professor Wong Hee Kit and Professor Pillay were wonderful and humbling. These new professional friendships and collegiality will last for many years.
This tribute is an excerpt taken from the speech given by me for Professor P Balasubramaniam on his 80th Birthday on 24th October 2009.

Many of us may never have the privilege to celebrate such an event. I hope each and everyone of us will maintain the mental alertness, sharpness and physical ability and drive to continue life’s journey like Professor Bala. (Figure 1)

He was born in Kuala Lumpur in Malaysia 80 years ago on October 26th. He lost his father during the Japanese Occupation when he was only 12 or 13 years of age. His mother and 3 astrologers foresaw a very bright future for this young man and prophesised that he will be a “Pandit” or a Professor in later life. He finished his education in Colombo, Sri Lanka, and went on to study Medicine with excellent results. During his surgical housemanship, he met and married Madam Ratnavali DeSilva. Subsequently he did his surgical fellowship in United Kingdom and came back to the University of Malaya as a Lecturer in Orthopaedic Surgery with Professor Francis DeSilva.

He became the sought after ‘Orthopaedic Man’ of the University and in no time was affectionately called ‘Watsy’ after Sir Watson Jones. He was promoted from Associate Professor to Full Professor in Malaysia in 1978. He widened his research and training working with Dr Coventry in the Mayo Clinic and Professor Hodgson in Hong Kong. In 1981, his eldest daughter Lucky was studying in Singapore. Professor Bala joined the University Department of Orthopaedic Surgery in November 1981 to be with her.

I had joined the department 3 months earlier as a Lecturer and when Professor Bala arrived, I was told to be his understudy. I still remember my first post call round with him. He scrutinised me thoroughly on the patients that were admitted and fortunately I passed his test.

During this time I was living at the McAlister Road Staff Quarters in Singapore General Hospital grounds which surprisingly still stands till today converted into the Nurse’s Quarters. (Figure 2)

I was sandwiched between Professor Bose’s flat on the top floor and Professor Bala’s flat below mine. Days will go by when I had to visit Professor Bala’s flat more frequently at odd times as my two naughty kids – Soumen and Sudeep – would have thrown their toys daily out of my verandah to fall on to Professor Bala’s landing.

Figure 1. Professor Balasubramaniam
Figure 2. McAlister Road Doctor’s Quarters at SGH
I remember the ever smiling face of his charming wife, Mrs Bala who would always invite me to have something to eat each time I entered the flat. Maybe that was my excuse to retrieve the toys, more than anything else. (Figure 3)

It was a devastating day for all of us when Mrs Bala left us from terminal breast cancer.

Professor Bala’s life was shattered at this point but he picked himself up and without any help, he looked after all the needs of his growing children. He would get up at 4.30 or 5 am to cook, wash and prepare the kids for school. He is now a happy grandfather with all his children married. His son is a cardiologist in the United States. (Figure 4)

Sometimes I cannot find words to describe or understand this man! When Professor Bala was promoted to a Full Professor in 1984, one of the perks of the University then was to present the new Professor with a lump sum of money to buy a car and the Volvo was often the trusted choice. Although Professor Bala previously drove the trustworthy Volkswagen Beetle in Malaysia, he told the University that he did not want this money and would not like to buy a car. The University Finance Department was shocked and did not know how to overcome this situation which they had never encountered in the past! Professor Bala had always led a very simple life. As the years rolled by, he alternated between being a vegetarian and a non-vegetarian. Money never really mattered to him. He always chose fixed allowance fees for his clinical practice rather than to receive private practice allowance all the years that he worked in the University. We should never underestimate Professor Bala’s gentle ways and take advantage of him. He is a man of discipline. He will frankly tell you when he feels unprofessional behavior of a doctor is observed. A young medical officer once came on his ward round, wearing a very bright, gaudy striped trousers. He gave him $10 for taxi fare and told him to go home and change.

Another rather small and timid but unkempt house officer was in the ward round wearing a crumpled, untidy shirt. He said, “I am not asking you to wear a designer shirt and tie. However, do you know how to iron a shirt? Or do you have an iron at home? Please go home, iron your shirt and come back neatly dressed.”

Some of you may know the story of one of our colleague who returned back from a long overseas leave growing a bushy beard. Professor Bala saw him in the ward round and gave him $2 to go to the barber and shave off his beard.

Another colleague of ours went through rigorous training with Professor Bala. At the end, he told Professor Bala “I have frightful respect for you, Prof Bala”.

Figure 3. Professor & Mrs Balasubramaniam

Figure 4. Professor Bala’s Family
Presently things, have changed – doctors coming in late intermittently at odd times for the 7.30am (now 7.15am) teaching sessions that we have in our Department. When Professor Bala was chairing a session, the latecomer would be told to leave the room and be severely reprimanded to be punctual.

I remember once, someone was projecting a poorly taken clinical photographic slide and kept on adjusting the focus of the projector to sharpen the image. Professor Bala said, “Stop! When the original picture is bad, no matter what you do you cannot improve it.”

I recently asked Professor Bala to reflect on his past days and he said that he may have been a bit tough and dogmatic at times. (Figure 5)

Despite his high regard for discipline, there was love, a twinkle in his eyes and encouragement for everyone. He never said no to anyone who sought his advice.

Professor Bala’s favourite cartilage was the Auricular Cartilage. (Figure 6) Once while operating with him on a scoliosis case doing a ‘Harry-Luque’ procedure, he told me “Shamal, you must learn how to use the Lexal nibbler to remove the ligamentum flavum properly. It is like nibbling your wife’s ear with your teeth – haven’t you done it?” I got a shock of my life!

Professor Bala has been a mentor to nearly every one of us giving us ideas and developing our research, teaching and clinical skills. He had great foresight.

Being his close neighbour, I had spent many evenings and late nights at his house writing and rewriting and revising from draft 1 to draft 7 on a topic for publication. He is a master of making a long complicated paragraph, easily readable in just 2 sentences. When I was complaining once about the dearth of hip cases in Singapore after my experience in the United Kingdom, Professor Bala said “Shamal, there is no such thing! You want to develop Hip Surgery, you cling to the ground and assist and get yourself involved with each and every one of all the consultant’s hip cases in the department.” With his encouragement and help, I think I have learnt a thing or two over the years.

There was of course the issue of the two Balas. (Figure 7) To prevent confusion between these two great man, one had to be called ‘Big Bala’ and the other ‘Small Bala’. ‘Small Bala’ never liked anyone calling him Professor Balasubramaniam. He said that it was too long and to just call him ‘Bala’. Graham Apley was a frequent visitor to the Postgraduate Course in Singapore and both he and Professor Bala got along well on the same wavelength and respected each other. (Figure 8)
Professor Bala is extremely humble. He once told me that his favorite tree was the Bamboo tree. It will grow big and strong but later having reached its height it will bow down with its branches and stoop down. (Figure 9) Prof Bala would stoop down very easily to anyone – rich or poor, VIP or non-VIP - to do things he felt right.

With his wealth of clinical experience and administration, he held several important positions in the hospital and later in the Dean’s Office even after his retirement. This 80th birthday function was organized by his grateful ‘FRCS Orthopaedic’ students who graduated in 2009. Among all the Postgraduate Courses held for those students, the ‘Bala’s Course’ has been the most popular.

Professor Bala has a very practical and useful analogy to life and medical practice. He said, as in driving, we can start in the slow lane, gain momentum and speed, change to the middle lane and then on to the fast lane. But don’t stay in the fast lane for too long as you will probably get burnt out very quickly. You must relax and come back to the middle lane and stay there till you change lane again on either side. However, don’t crawl in the slow lane all your life!

Even now, Professor Bala keeps his brain active by cooking, updating computer knowledge, keeping abreast with new medical knowledge, writing poetry and now he is on to water color painting and has drawn Lord Ganesha in over 30 poses. (Figure 10) He is active in teaching postgraduates in Singapore, Malaysia and Indonesia.

Professor Bala is a great Teacher, Researcher, Philosopher and Original Thinker respected by all. We wish him many more years to come. May he continue to mentor more bright young orthopaedic surgeons and trainees to follow in his footstep.
SPECIAL AWARDS
National Outstanding Clinician Award 2012

Professor Wong Hee Kit

“For his outstanding and immense contributions in the field of musculoskeletal disorders, in particular spinal surgery”

Professor Wong is a trailblazer in the field of orthopaedic surgery. The advancements that he has introduced in the surgical treatment of musculoskeletal disorders, in particular spinal surgery, have put both NUH and Singapore on the world map.

He is credited with pioneering many new treatment methods, including the minimally invasive surgical technique of thoracoscopic anterior spinal fusion for scoliosis, which he later paired with instrumentation. Other treatment methods introduced by Professor Wong include posterior lumbar interbody fusion, transforaminal lumbar interbody fusion, minimally invasive anterior lumbar interbody fusion, artificial lumbar disc replacement and artificial cervical disc replacement. Today, Professor Wong is among a handful of surgeons around the world to have honed the minimally invasive surgical technique to a fine art. His surgical case profile includes many complex spinal surgical procedures and minimally invasive spinal surgery.

In 2007, Professor Wong set up the University Spine Centre at NUH, the first of its kind in Singapore that is dedicated to the management of spinal disorders.

Professor Wong is a prolific researcher dedicated to his orthopaedic specialty. Some of his recent research projects include the epidemiology and treatment of adolescent and adult scoliosis, pathophysiology of spinal nerve root compression, lumbar interbody devices, and novel spinal fusion solutions for the treatment of low back pain. As a testament of Professor Wong’s accomplishment in the field, NUH was selected as the first worldwide site for a ‘first-in-human’ clinical trial for a new minimally invasive non-fusion device to correct scoliosis.

Professor Wong’s leadership and involvement in his areas of clinical expertise is wide. His reputation as an outstanding clinician has attracted many students and international fellows to train in spinal surgery in NUH, and earned him countless invitations to lecture in international spine conferences, postgraduate training programmes as well as to perform surgery in the region and around the world. His reputation has also earned him regular international referrals -- from Asia, the Middle East, as well as North America -- and second opinion referrals for complex cases.

Professor Wong has served in committees at the international, national, and university levels. He was the immediate past Chairman of the Spine Section of the Asia Pacific Orthopaedic Association, Board Member of the International Society for the Advancement of Spinal Surgery and Pacific Asian Society for Minimally Invasive Spinal Surgery, an active member of the Scoliosis Research Society (SRS) and International Society for the Study of the Lumbar Spine (ISSLS).

For his outstanding and immense contributions in the field of musculoskeletal disorders, in particular spinal surgery, Professor Wong Hee Kit is awarded the National Outstanding Clinician Award 2012.
Professor Wong Hee Kit was awarded the Master Clinician Award in October 2011 for his outstanding contributions to clinical care at the inaugural NUHS Leadership Awards. Professor Wong is an unparalleled leader in the field of Orthopaedic Surgery. The advancements that he has introduced in the surgical treatment of musculoskeletal disorders, in particular spinal surgery, have made Singapore and NUH a brand name. He is known for pioneering many new treatment methods, for example the minimally invasive surgical technique of thoracoscopic anterior spinal fusion for scoliosis, which he later paired with instrumentation. He has also introduced and pioneered other treatment methods like posterior lumbar interbody fusion, transforaminal lumbar interbody fusion, minimally invasive anterior lumbar interbody fusion, artificial lumbar and cervical disc replacement, and non-fusion growth modulation surgery for idiopathic scoliosis. Today, Professor Wong is one of a handful of surgeons around the world who has honed the minimally invasive surgical technique to a fine art. His surgical case profile includes many complex spinal surgical procedures and minimally invasive spinal surgery. In 2008, he set up the University Spine Centre, the first in Singapore dedicated to the management of spinal disorders. Out of the operating theatre, Professor Wong is also a committed teacher and educator, someone who is constantly pushing for new levels of excellence in his chosen field. He is also dedicated to his specialty and is involved in multiple research projects to bring it to an even higher level.

Healthcare Humanity Award 2011

Associate Professor Joseph Thambiah has been actively involved in humanitarian work. He first led a team of doctors and nurses to Yogyakarta to provide relief to the victims of the devastating earthquake in Bantul in 2006. He was instrumental in setting up the Batam Medical Outreach, where a team of doctors, nurses and non medical volunteers go on a bimonthly medical mission to Batam to provide primary healthcare and health education to the villagers there. He also helps to run the Mobile Medical Service which aims to provide free primary healthcare to the less privileged segments of Singapore society. For his extraordinary dedication and selflessness to the community, Professor Thambiah was awarded the 2011 Healthcare Humanity Award by Mr S R Nathan, President of Singapore, at the Istana on 31st May.
Healthcare Humanity Award 2011

One who is sincere in wanting to ‘make the difference’ in the lives of the less fortunate, Nurse Manager Irene Yeo Kah Keow is always enthusiastic to participate in voluntary activities, spanning from union-organized activities to personal mission trips. She is a volunteer for the Batam Medical Outreach since 2010 and together with her team, pays home visits to one roomers in Chai Chee area. Irene was awarded the 2011 Healthcare Humanity Award for her exemplary care to patients and outstanding contributions outside work. She received the award from Mr S R Nathan, President of Singapore, at the Istana on 31st May 2011.

Ms Irene Yeo, Nurse Manager,
University Orthopaedics,
Hand and Reconstructive
Microsurgery Cluster, National
University Health System.

NUS Annual Safety and Health Performance Award 2011

Our department won the NUS ASPHA Silver Award in 2011, which consists of a cash prize of S$35,000 and a plaque. The NUS Annual Safety & Health Performance Award (ASHPA) is an annual award presented by Office of Safety, Health & Environment (OSHE), in recognition to departments that have performed well in safety and health through the implementation of safety and health management system. This is the second year that the department has participated in ASHPA, having won a Merit with commendation in 2010. This award reaffirms our department’s ongoing commitment in maintaining the highest health and safety standards in our research laboratories.
Lee Foundation – NHG Lifetime Achievement Award 2008

Professor Lee Eng Hin is well respected as a leading Paediatric Orthopaedic Surgeon and for his role in developing Paediatric Orthopaedics in Singapore. He is also internationally known for his stem cell research and work on cell based therapy in the repair and regeneration of musculoskeletal tissues. During his term as Dean of National University of Singapore School of Medicine, he oversaw the curriculum review of the undergraduate medical programme and nurtured an environment to facilitate teaching and research. He has mentored many young clinicians, many of whom have gone on to become outstanding clinician scientists in their respective areas. This prestigious award specifically recognises his training of young clinicians and the setting up of a conducive environment for learning and research.

"I am deeply honoured and humbled by this award. One of the main reasons I am in academic medicine is my passion for teaching. Our medical students and young doctors are constantly stimulating and challenging me so that I have to continually keep up with their enquiring minds. I feel privileged to be in a position where I can nurture and guide so many young doctors and scientists who are our future leaders in healthcare and research."

– Professor Lee Eng Hin

Lifeline Apr - Jun 2008

National Outstanding Clinician Mentor Award 2008

The NHG Lifetime Achievement Award was presented to Professor Lee Eng Hin at the NHG Annual Scientific Congress in November 2008. Professor Lee is a world renowned clinician scientist and an outstanding Paediatric Orthopaedic Surgeon. He has won many accolades for his immense contributions as a clinician and researcher. He was a previous Head of the Department of Orthopaedic Surgery at National University of Singapore and National University Hospital, and at the KK Women’s and Children’s Hospital. In addition, he was also Dean of the Faculty of Medicine at NUS from 2000-2003. He was the founding Director of NUSTEP, the NUS Tissue Engineering Program. In recognition of his outstanding achievements in research and excellent track record, he was awarded the University Outstanding Researcher Award in 2006. In 1984, Professor Lee initiated a Seating for Severely Disabled Children, a project sponsored by the World Orthopaedic Concern to help children who otherwise were unable to sit. He also helped to set up the Margaret Drive Special School, Rainbow Centre and Balestier Special School. Professor Lee chaired a committee set up by the National Council of Social Services to study the feasibility of helping physically disabled children integrate into normal schools. For his selfless contributions to the community, he was awarded the Public Service Medal in 1998; the Public Administration Medal (Silver) in 2003; and the prestigious President’s Social Service Award in 2004.
Lee Foundation – NHG Lifetime Achievement Award 2004

Emeritus Professor Robert Pho receiving the award from the late Dr Balaji Sadasivan, Senior Minister of State, Ministry of Health.

Professor Robert Pho was honoured by the National Healthcare Group with the Lee Foundation-NHG Lifetime Achievement Award in October 2004 during the NHG Annual Scientific Congress. The Lee Foundation-NHG Lifetime Achievement Award is the highest and most prestigious award presented to recognise individuals who have made significant contributions to NHG institutions and Singapore, particularly in the development of healthcare services and the well-being of Singaporeans. An extraordinary clinician and leader, Professor Pho has made numerous contributions in the local and international medical arena. His willingness to consider all medical possibilities and his enthusiasm for continuous learning has made him a pioneer in Reconstructive Microsurgery. He is the founding Chief of the Department of Hand and Reconstructive Microsurgery. He is the “Father” of Hand Surgery and Reconstructive Microsurgery in Singapore, and continues to push the frontiers for these disciplines even now. World renowned for his surgery and research, Professor Pho is a much sought-after speaker at many international meetings. Among his list of firsts are re-attaching a thumb in 1977, grafting a toe to replace a thumb in 1978 and using a bone from the calf to replace one in the thigh in 1977. In addition, when he encounters cancer - infected bone in his patients, Professor Pho removes it, pops it into the microwave oven to kill the cancerous cells and re-implants it in the person. He has been doing this since 1988 rather than using an expensive prosthesis or a bone graft as it prevents cancer from migrating to other parts of the body and reduces chances of infection.
RESEARCH AWARDS
Professor Lee Eng Hin was awarded the NUS Outstanding Researcher Award in 2006. This award recognizes researchers whose work have impacted and advanced the frontiers of knowledge. Professor Lee is an outstanding clinician scientist of international repute. His research interests range from stem cell biology and regenerative medicine, tissue engineering of musculoskeletal tissues to gait analysis and paediatric orthopaedics and rehabilitation. He is a pioneer in the study of mesenchymal stem cells for the repair and regeneration of chondral defects in adults and physeal defects in long bones of children. His research achievements include the use of biodegradable 3-D scaffolds as carriers for cells and growth factors to promote healing and repair of musculoskeletal tissues. He has a deep passion for discovering new knowledge to provide and improve medical care to those suffering from growth arrest and cartilage defects and to develop innovative solutions to clinical problems.

He was the only person outside North America to win research awards twice from the Paediatric Orthopaedic Society of North America – the David H Sutherland Pioneer Award (1993) and the Robert B Salter Scientific Paper Award (1996) – for Most Outstanding Basic Science Research Paper. He also won the Gallie-Bateman Prize for Research in Basic Science in 1979.

Professor Lee has published extensively in international journals such as Tissue Engineering and Stem Cells and Cell Transplantation as well as other peer-reviewed clinical journals such as American Journal of Sports Medicine and Journal of Bone and Joint Surgery. He has co-authored a book with Ariff Bongo entitled “Stem Cells: from Bench to Bedside” which has been adopted by many centers internationally as a standard text for stem cell courses. He delivered a talk on “The Potential of Stem Cells in Orthopaedic Research” as the Presidential Guest Speaker at the British Orthopaedic Association Meeting in September 2004.

He is a member of International Paediatric Orthopaedic Think Tank, a prestigious group of the world’s top 70 paediatric orthopaedic surgeons. He is a member of the editorial boards of several international refereed journals in orthopaedic surgery and basic research and reviews regularly for high impact journals in orthopaedics, stem cells and tissue engineering. Professor Lee’s research aspiration is to utilise and capitalise on clinical expertise and research skills, for knowledge to be translated into novel clinical applications so as to achieve positive therapeutic outcomes.
OBJECTIVE:

Medial patellofemoral ligament (MPFL) reconstruction is a possible surgical option for recurrent patella instability. Currently, there are many variations in techniques, graft materials and fixation choices available. One of the most feared and rare complication is a fracture of the patella following MPFL reconstruction. This paper presents a case of atraumatic patellar fracture following MPFL reconstruction and provides a literature review of similar cases to highlight possible causes and preventive measures.

METHODOLOGY:

Our case presentation is on a 29 year old male who suffered a transverse patellar fracture at 13 weeks after MPFL reconstruction.

RESULTS AND CONCLUSION:

We propose that a possible cause of the fracture was due to surgical failure of a single large screw tunnel and present a literature review on similar cases. Treatment with tension band wiring fixation was successful.
Effect Of Sphingosine-1-Phosphate On An Implant Infection Simulation Model Using Lipopolysaccharide-Treated Differentiating Osteoblasts Cultured On Titanium Substrate Grafted With BMP-2 And Chitosan: An In Vitro Cellular And Molecular Study

Lim Tee Yong, Poh Chye Koon, Wilson Wang

OBJECTIVE:

Bacterial endotoxins like lipopolysaccharide (LPS) can induce a strong immune response at a bone implant site which can lead to implant failure through deleterious effects on bone-implant integration. In this study, we investigate whether sphingosine-1-phosphate (S1P), a known immune modulator, has any beneficial effects in an implant infection simulation cellular model exposed to bacterial LPS.

METHODOLOGY:

Developing osteoblasts derived from human mesenchymal stem cells are grown on a surface modified titanium substrate, and then subjected to LPS treatment or LPS/S1P co-treatment.

RESULTS:

After 1 day exposure, the gene expressions of Toll-like receptor 4 (TLR4), an LPS-binding ligand, and tumour necrosis factor alpha (TNFα), a major inflammatory cytokine, were downregulated with the LPS/S1P co-treatment. This suggests that S1P may be able to induce LPS tolerance in the differentiating osteoblasts. During prolonged LPS exposure (7 days), the gene expressions of Runx2 and osteocalcin were upregulated in the LPS/S1P co-treatment. These are characteristic of osteoblast function and the findings suggest that S1P can likely maintain the bone cell characteristics of differentiating osteoblasts in a LPS environment.

CONCLUSION:

Thus, S1P appears to be of benefit to differentiating osteoblasts during LPS exposure, by inducing LPS tolerance in, and maintaining the integrity of, the osteoblasts, and it warrants further investigation as a therapeutic agent in implant-related infections.
OBJECTIVE:

A comparative study is performed between three conditioning regimes of continuous levels (high and low intensity) and rehabilitative regime, with static culture as control.

METHODOLOGY:

Scaffolds of knitted silk fibroin with aligned electrospun silk fibroin (SF-AL) were seeded with rabbit bone marrow stromal cells (rBMSCs, P2, 1.5x10^6/scaffold) and cultured statically for 3 days before loading into a customized bioreactor. Continuous low and high intensity, with different cyclic frequency (0.1Hz (4320cycles/day) and 0.5Hz (21600 cycles/day) respectively), were applied for the two groups (“Low” and “High”) through the 28 days study. The group undergoing rehabilitative regime (“Rehab”) would be exposed to “Low” (D3-D7) and “High” (D7-D28). All other parameters were constant.

RESULTS:

Cell proliferation: “High” showed significantly lower proliferation rates than other groups from D3 to D7. “Rehab” showed a deviation from its proliferative phase from D14.

Collagen deposition: Significantly more collagen deposition in “Rehab” between D14 and D28 as compared to other groups, indicating the group undergoing a differentiative phase.

Mechanical properties: “Rehab” had significantly higher strength and stiffness than other groups by D21 with breaking load and elastic stiffness at D28 measured as 238±19 N and 44.4± 2.8 N/mm respectively.

Histology: Sections in “Rehab” and “Low” showed aligned collagen deposition with “Rehab” having larger bands of collagen fibrils with crimp pattern at D28.

CONCLUSION:

Through this comparative study, a preliminary outlook of a suitable mechanical stimulation regime was presented. “Rehab” was shown to be a better stimulation approach of MSCs towards the regeneration of ligament/tendon tissue when compared to other continuous stimulation regimes.
OBJECTIVE:

With its little ability to adapt, the muscle is the main limiting factor for limb lengthening. Under the influence of tension, it will either experience local necrosis or fibrosis. The formation of new muscle tissue depends on the muscle satellite cells. Continued distraction and depletion of the satellite cells will lead to fibrosis, which in turn lead to weakness of the lengthened muscles, contraction of soft tissues, subluxation and dislocation of the adjacent joints.

In order to reduce complications and to improve on the current clinical methods of limb and bone lengthening, we hereby propose an idea of increasing the number of muscle satellite cells through the injection of muscle derive stem cells (MDSCs). Our aim is to test the hypothesis that injection of Muscle Derived Stem Cells into a distracted muscle will increase the capability of the muscle to grow without interfering with its contractility.

METHODOLOGY:

Twelve immature New Zealand White rabbits were divided into 2 groups. All animals underwent tibia osteotomies and distraction with monorail external device. The experiment group was injected with MDSCs, from one week following the operation and the control group, with a saline. Both groups subsequently experienced distraction at the rate of 1mm/day after an initial lag of 1 week, until 30% of the original limb length is achieved. All animal were sacrificed after one month consolidation.

The histological differences in morphology and function were then analyzed between experiment group and controls.

RESULTS:

In the control group, atrophic fibers and regeneration, typically seen in lengthened muscles were noted under histological analysis. In the experimental group however, normal muscle architecture with closely packed polygonal muscle fibre profiles were seen.

CONCLUSION:

The results in the rabbit model were statistically significant and showed that muscle derived stem cells improved the morphology of lengthened muscles. Stem cell administration is helpful for muscle regeneration in context of limb lengthening. In clinical practice, this finding should improve the technique of limb lengthening, without causing the undesired complications associated with such procedures. This will lead to the extended use of this technique to correct major limb-length discrepancy.
Finalist, Best Clinical Paper Award. The 2010 Pediatric Orthopaedic Society of North America (POSNA)/Asia Pacific Orthopaedic Association (APOA) Annual Meeting, Waikoloa, Hawaii, 4-7 May 2010

Long Term Follow Up Of Pulmonary Function And Scoliosis In Patients With Duchenne’s Muscular Dystrophy And Spinal Muscular Atrophy

Kenon Chua, James Hui Hoi Po, Wong Hee Kit, Lester W Chan, Lee Eng Hin, Daniel Goh

OBJECTIVE:

To review the long term results of spine surgery and its effect on pulmonary function in patients with neuromuscular scoliosis secondary to Duchene’s Muscular Dystrophy (DMD) and Spinal Muscular Atrophy (SMA).

METHODOLOGY:

A retrospective review was conducted for the above patients who had undergone surgery from 1992-2006. Their yearly lung function tests, clinical records and X-ray films before and after surgery were reviewed. All patients had at least 2 lung function tests done before surgery and at least 3 lung function tests done after surgery.

RESULTS:

37 patients were reviewed: 27 with DMD, 10 with SMA. The follow up period was 10.1 years (range: 13-17 years). The patients in the study underwent posterior surgery. The mean age at scoliosis surgery for patients with DMD was 14.7 years (range: 13-7 years). The mean Cobb’s angle preoperatively for patients with DMD was 56.4 degrees (range: 44.3-69.1 degrees). The mean Cobb’s angle post operatively was 22.8 degrees (range 18.2 – 24.4 degrees). The mean correction for the patients with DMD was 33.6 degrees. The yearly decline in percentage predicted forced vital capacity pre-operatively was 8.2 percent (95% CI: 12.2% to 3.0%). This was reduced to 3.2 percent (95% CI: 14.1 to 3.8 percent) post operatively. For patients with SMA, the mean age at scoliosis surgery was 9.5 years (range: 7-12 years). The mean Cobb’s angle pre-operatively for patients with SMA was 66.2 degrees (range: 43.2 – 91.1 degrees). The mean Cobb’s angle post operatively was 22.5 degrees (range: 12.1 – 46.4 degrees). The mean correction for the patient with DMD was 43.7 degrees (range: 28.2 – 91.1 degrees). The yearly decline in percentage predicted forced vital capacity pre-operatively was 7.9 percent (95% CI: 10.2% to 2.1%). This was reduced to 3.5 percent (95% CI: 9.1 to 2.9 percent) post operatively.

CONCLUSION:

Spinal stabilization and fusion in children with scoliosis secondary to DMD and SMA is safe and effective. This study suggests the pulmonary function in DMD and SMA continues to decline after scoliosis surgery, though the rate of decline is less marked. The post operative rate of decline is stable, and does not degenerate back to the pre-operative rate of decline even in patients followed up for more than 10 years. The long follow up period (>10 years), demonstrated that scoliosis surgery in patients with DMD and SMA offered long term benefits in terms of pulmonary function.
OBJECTIVE:

The results of surgical treatment for tarsal tunnel syndrome have been suboptimal, especially in the absence of space-occupying lesions. We attribute this to a poor understanding of the detailed anatomy of the ‘tarsal tunnel’ and potential sites of nerve compression.

METHODOLOGY:

This study involved the dissection of 19 cadaver feet. All findings and measurements were documented with still digital photography.

RESULTS:

This study demonstrates three well-defined, tough fascial septae in the sole of the foot. In addition to the flexor retinaculum and the abductor hallucis, two of these septae represent potential sites of compression of the posterior tibial nerve and its branches. The flexor retinaculum is a common point of compression for the posterior tibial nerve and its branches. The medial and lateral plantar nerves may be compressed beneath the fascial origin of the abductor hallucis and the muscle itself. The medial plantar nerve may be entrapped under the medial septum. However, in the 16 out of 19 feet, the medial plantar nerve skirted and did not traverse beneath the septum. The lateral plantar nerve traversed beneath the medial septum in all specimens. The nerve to abductor digiti minimi may be trapped under the medial and intermediate septum.

CONCLUSION:

A better understanding of the anatomical relationships of the tarsal tunnel and a clear communication system among anatomists, neuroradiologists and foot and ankle surgeons will facilitate accurate preoperative localization of the site of nerve compression and possibly selective surgical releases, leading to better outcomes and minimal morbidity.
OBJECTIVE:

We present the preliminary results of a minimally-invasive technique of cartilage repair in the human knee combining arthroscopic microfracture with outpatient autologous mesenchymal stem cells (MSCs) and hyaluronic acid (HA) injections. This novel technique is a phase one translational trial based on the results of our porcine model and our main objective is to establish the safety of this novel procedure and assess its potential for further investigation.

METHODOLOGY:

Thirty-one patients (35 knees) with symptomatic cartilage defects of the knees were treated with the proposed technique. Patients were monitored for adverse effects and prospective evaluation of clinical outcomes was performed at regular intervals for a minimum twelve months period.

RESULTS:

At final follow up (mean+24.5 months) there was an improvement in mean Lysholm score from 47.7 (pre-operatively) to 77.7 (Post-operative score). IKDC, SF-36 physical component score and VAS Pain scores were also noted to have significant improvements. There was also a time-dependent effect in all 4 parameters highlighted above (p<0.001). Males tend to fare better than females at the IKDC assessment and SF-36. Physical Component Score (PCS). No adverse events were reported.

CONCLUSION:

The primary objective of this study to establish its safety was achieved. We have now embarked on a randomized controlled trial to evaluate its efficacy.
OBJECTIVE:
Osteochondral defects arise because of trauma or disease and conventional therapies are inadequate in addressing the pathology. The objective of the study is to evaluate a novel technique of cartilage tissue engineering using a biphasic osteochondral scaffold seeded with autologous Mesenchymal Stem Cells (MSC) and a membrane in a large weight bearing animal model.

METHODOLOGY:
The experiment was divided into 3 groups. Groups A had a dual phase construct comprising of a cartilage. Polycaprolactone (PCL) scaffold and a Polycaprolactone-Tri Calcium Phosphate (PCL-TCP) osseous matrix. Autologous Mesenchymal Stem Cells (MSC) was seeded into the entire implant via fibrin and the construct was inserted into critically sized osteochondral defects located at the medial condyle and patellar groove of pigs. The site was then resurfaced with a novel electrospun membrane that served as a periosteum substitute in reducing cell leakage. Group B was devoid of membrane and Group C was devoid of MSC. Tissue repair was evaluated for both the medial condyle and patella groove after 6 months in all 3 groups (6 pigs in each group).

RESULTS:
Cartilage repair was observed with a low occurrence of fibrocartilage at the medial condyle. The enhanced healing arrested host cartilage degeneration as shown by superior Glycosaminoglycan (GAG) maintenance. The positive morphological outcome was supported by higher relative Young’s modulus indicating functional cartilage restoration. Bone in growth was enhanced in the experimental group. Healing was compromised in the absence of the implanted cells or resurfacing membrane. Furthermore, tissue repair was inferior at the patellar groove as compared to the medial condyle and this was attributed to the unique biomechanical conditions at the site.

CONCLUSION:
The MSC seeded biphasic implant coupled with an electrospun membrane assisted osteochondral healing and this was evidenced by histological findings and biomechanical testing.
OBJECTIVE:
We have previously shown that osteosarcomas have states of increased interstitial fluid pressure (IFP) which correlate with increased proliferation and chemosensitivity. In this study, we hypothesized that constitutively raised IFP in osteosarcoma regulates angiogeneses.

METHODOLOGY:
Sixteen patients with the clinical diagnosis of osteosarcoma underwent blood flow and IFP readings by the wick-in-needle method at the time and location of open biopsy. Vascularity was determined by capillary density in the biopsy specimens. We performed digital image analysis of immunohistochemical staining for CD31, VEGF-A, VEGF-C and TPA on paraffin-embedded tissue blocks of the biopsy samples. Clinical results were validated in a pressurized cell culture system.

RESULTS:
IFPs in the tumours (mean 33.5 SD 17.2 mmHg) were significantly higher (P=0.00001) than that in normal tissue (2.9 5.7 mm/Hg). Pressure readings were significantly higher in low vascularity tumours compared to high vascularity tumours (P<0.001). In the osteosarcoma cell lines growth in a pressurized environment was associated with VEGF-A downregulation VEGF-C upregulation and TPA upregulation. The reverse was seen in the OB cell lines. Growth in the HUVEC cell line was not significantly inhibited in a pressurized environment. Immunohistochemical assessment for VEGF-A (P=0.01), VEGF-C (P=0.008) and TPA (P=0.0001) translation were consistent with the findings on PCR.

CONCLUSION:
Our data suggest that some molecules in angiogenesis are regulated by changes in IFP.
Adolescents Undergoing Surgery For Adolescent Idiopathic Scoliosis: Does Surgery And Surgical Technique Affect Patient Outcomes?

John Ruiz, Haley Hernstadt, Ling Lim, WK Lim, Hee Hwan Tak and Wong Hee Kit

OBJECTIVE:

Our objective was to determine if scoliosis surgery and surgical technique used to treat a cohort of patients with the same type of scoliosis deformity affects patient outcome.

METHODOLOGY:

Patient outcomes using the Scoliosis Research Society (SRS) questionnaire after thoracoscopic and posterior surgical techniques for thoracic idiopathic scoliosis were compared after >2 years post-op. Additional comparisons were made with non-operated scoliosis and normal patients. The SRS-24 questionnaire was prospectively administered to 4 groups of patients:

1. 42 patients with thoracic idiopathic scoliosis who underwent thoracoscopic instrumented fusion surgery (thoracoscopic group);
2. 42 patients with thoracic scoliosis who underwent posterior instrumented fusion surgery (posterior group);
3. 97 patients with thoracic scoliosis who did not have surgery (scoliosis control group);
4. 72 patients who did not have scoliosis (normal group).

The 2 surgical groups were comparable with regards to age at surgery, pre-op Cobb and follow-up. SRS-24 domain scores were computed for all 4 groups and were compared on SPSSv13 software.

RESULTS:

Our results show the thoracoscopic group having a significantly smaller mean post-op Cobb (17° vs 25.1°, respectively; p<.001), which was achieved using less fusion segments (7 vs 9.3 segments, respectively; p<.001). The mean Cobb of the scoliosis control group was significantly larger than the post-op Cobb of the thoracoscopic group (p<.001), and was comparable to the post-op Cobb of the posterior group. Comparing the 2 surgical groups, the thoracoscopic group showed trends towards better scores in 4 of the SRS-24 domains compared to the posterior group, but this only reached statistical significance for the satisfaction domain (p<.05). When comparing the 4 groups, Pain scores of both surgical groups were similar to those who did not have surgery, and were worse than normal patients (p<.0001); Self-image scores after surgery were higher than those who did not have surgery(p<.05) and were comparable to normal patients; Function and Activity scores of the thoracoscopic group was significantly inferior to the scoliosis control group (p<.05).

CONCLUSION:

Our study demonstrates that >2 years after surgery, both thoracoscopic & posterior surgery resulted in pain scores that were similar to patients with scoliosis that did not have surgery, and were worse than the normal group. However, both surgical techniques resulted in self-image scores that are comparable to normal individuals despite a difference in post-op Cobb. When comparing the two surgical techniques, the SRS-24 showed no difference between the 2 surgical techniques, except for patient satisfaction which was better in the thoracoscopic group.
OBJECTIVE:

Mechanical forces and BMP-7 are important modulators of IVD degeneration. However, the detailed response of human IVD cells to dynamic tension and BMP-7 has never been studied and it has never been shown whether pre-compressed human IVD cells can be regenerated under dynamic tension and BMP-7. To investigate whether dynamic tension and BMP-7 on pre-compressed human IVD cells can reverse the biosynthesis of collagen and glycosaminoglycan.

METHODOLOGY:

An in vitro study whereby equibiaxial cyclic tension and BMP-7 was applied to cultured pre-compressed annulus fibrosus (AF) and nucleus pulposus (NP) cells of human intervertebral disc (IVD). AF and NP tissues of adolescent idiopathic scoliosis cases undergoing thoracoscopic discectomy and fusion were cultured on compressive plates. Compressive loads were applied to the AF and NP tissues, followed by equibiaxial cyclic tension and BMP-7 to deform the released cells onto the plate’s flexible bottom.

RESULTS AND CONCLUSION:

We found that equibiaxial cyclic tension combined BMP-7 at a rate of 1 Hz with 10% strain have significant increase in glycosaminoglycan and collagen synthesis, and proliferation of pre-compressed AF and NP cells than those that was only subjected to equibiaxial cyclic tension.
**Outstanding Oral Paper Award. The 13th International Conference on Biomedical Engineering, Singapore, 3-6 Dec 2008**

Fusion performance of a polycaprolactone based bioresorbable cage used in a porcine model of anterior lumbar interbody fusion

Abbah Sunny Akogwu, Christopher Lam, Yang Kai, James Goh, Dietmar Hutmacher, Wong Hee Kit

**OBJECTIVE:**

Spine fusion, a procedure commonly performed for patients with debilitating back pain, often involves implantation of metallic cages and autograft bone into intervertebral disc spaces. Several problems could be associated with the use of both metallic cages and autograft bone including: stress shielding effects due to mechanical incompatibility of metals with host bone, inaccuracies with radiographic assessment during follow-up and donor site morbidities like chronic pain and visceral hernia. Bioabsorbable cages (biocage) could offer distinct advantages including biological and mechanical compatibility with host bone. The present study aims to evaluate the efficacy of mPCL-TCP biocages used in combination with MSCs and rhBMP-2 for spine fusion.

**METHODOLOGY:**

Twelve (12) pigs underwent anterior lumbar interbody fusion (ALIF) at L3/4 and L5/6 in four groups viz: Biocage; Biocage + MSCs; Biocage + rhBMP-2 (0.6mg/level); and Autograft bone, implanted for 3 and 6 months.

**RESULTS:**

All motion segments receiving rhBMP-2 showed radiographic evidence of fusion as early as 3 months. Autograft bone showed fusion only in 50% cases at this time point. Biocage and biocage + MSCs did not show any fusion. Similar results were observed at 6 months. Micro-CT, histology and mechanical testing further confirmed these findings.

**CONCLUSION:**

Incorporating low dose rhBMP-2 onto mPCL-TCP promoted early fusion compared to autograft bone. Failure of MSCs to stimulate early fusion is in variance with previously observed ectopic ossification in rats and could indicate a less than optimal environment for these cells. Rate of scaffold degradation was also observed to progress faster in the rhBMP-2 group. This is the first study reporting mPCL-TCP application in a large animal model of spine fusion and confirms the suitability and potentials of this scaffold to deliver low dose rhBMP-2 for use in a weight bearing bone regeneration site in large animals.
Outstanding Poster Paper Award. The 13th International Conference on Biomedical Engineering, Singapore, 3-6 Dec 2008.

A serum free medium that conserves the chondrogenic phenotype of in vitro expanded chondrocytes

Ho Saey Tuan Barnabas, Yang Zheng, Hui Hoi Po James, Oh Kah Weng Steve, Choo Boon Hwa Andre, Lee Eng Hin

OBJECTIVE:

The success of autologous chondrocyte implantation hinges on several factors. One of which is that sufficient chondrocytes with a conserved phenotype is required for the procedure. This proves to be a challenge with conventional cell culturing which is dependent on animal serum. The authors propose a serum free media that not just enhance cell growth but also preserve the chondrogenic phenotype during expansion.

METHODOLOGY:

Chondrocytes were harvested from human articular cartilage biopsies and cultured either in serum supplemented media or in the serum free formulation. To promote cell attachment, collagen or fibronectin coating was coupled to the use of the serum free media. During expansion, cell attachment and proliferation were evaluated, while key chondrogenic markers were assessed in the later redifferentiation phase.

RESULTS:

Promising results were observed with superior long term proliferation as compared to the FBS supplemented cultures. When these cells were redifferentiated, aggrecan and collagen II were expressed especially so for the cells cultured on collagen coated surfaces under serum free conditions. These cartilage ECM molecules were either reduced or absent in the FBS group. The serum free formulation also lowered collagen X gene expression which was indicative of a reduced likelihood of the cells undergoing hypertrophy.

CONCLUSION:

The work represents one of the first attempts in the in vitro expansion of human chondrocytes independent of serum or its derivatives. The findings indicate that serum free media on collagen and fibronectin substrates supported higher cell proliferation and better chondrogenic phenotype compared to serum supplemented media.
OBJECTIVE:

Knee osteoarthritis is a prevalent disease worldwide and is characterized by progressive degeneration in structure and functionality of the articular cartilage. While it is widely suggested that activities involving large landing impact loads may lead to post-traumatic osteoarthritis, there is little understanding on whether these loads can inflict cartilage lesions and trigger degeneration. This study sought to investigate whether landing impact loads applied to the osteocartilage will render it towards degeneration.

METHODOLOGY:

Menisci-covered and exposed osteochondral explants were extracted from tibial cartilage of fresh porcine hind legs and placed in culture for up to 14 days. A single 10-Hz haversine impact compression was performed at Day 1. Control (non-impact) and impacted explants were randomly selected for cell viability, glycoaminoglycan and collagen content assessment, histology, immuno-histochemistry and micro-computed-tomography.

RESULTS:

When 2-mm displacement compression was applied, exposed explants attained a considerably greater peak impact stress than menisci-covered explants. There was no observable difference in cell viability, glycoaminoglycan and collagen content, and Mankin scores between menisci-covered and exposed explant groups. Both groups were noted with diminished proteoglycan and type II collagen staining at Day 14; the exposed group indicated increased cartilage volume at Day 7-14.

CONCLUSION:

Large landing impact loads can introduce structural damage to the osteocartilage, which leads to osteoarthritis-like degenerative changes. The inferior resilience of menisci-covered regions, against impact-induced damage and degeneration, may be a key factor involved in the meniscectomy model of osteoarthritis.
OBJECTIVE:
To evaluate the fusion performance of a biocage, PCL-TCP, designed with distinct architecture for bone healing under load-bearing conditions.

METHODOLOGY:
Twelve pigs (40-50kg) underwent a two-level (L3/4;L4/5) anterior lumbar interbody fusion (ALIF) surgery in four groups (Figure 1 & 2).

RESULTS:
X-ray at 12 and 24 weeks revealed fusion in motion segments receiving biocage + rhBMP-2 and autograft bone implants (Fig. 2). Standalone biocage and biocage + MSCs failed to induce fusion. Micro-CT, histology and mechanical testing confirmed these findings with new bone ingrowth observed in all groups except standalone biocage.

CONCLUSION:
Incorporating low dose rhBMP-2 onto PCL-TCP promoted early fusion comparable to autograft in this model. This indicates a mechanically stable environment provided by the cage for fusion. Absence of fusion in standalone biocage was not unexpected due to lack of osteoinductive components. Failure of MSC to stimulate early fusion could indicate a less than optimal environment or cell number. Prolonged implantation or increase seeded cell number could be an option. This is the first study reporting PCL-TCP application in a multi-level ALIF model and confirms that this uniquely designed scaffold is able to provide adequate initial stability and disc space distraction required for fusion in ALIF.
OBJECTIVE:

Few in vivo studies had previously been attempted in reaffirming the in vitro data in current literature. This study evaluated the ability of mesenchymal stem cells (MSCs) isolated from bone marrow, periosteum and fat to treat partial growth arrest in immature New Zealand white (NZW) rabbits.

METHODOLOGY:

A physeal arrest model in an immature rabbit was created. The bony bridge was excised 3 weeks later, and MSC from various sources were transferred into the physeal defect of different rabbits. Group I consisted of bone marrow-derived MSCs, Group II: periosteum derived MSCs, Group III: fat-derived MSCs Contra-lateral tibiae, without undergoing operation, served as self-control. The animals were subsequently sacrificed, with radiological and histological analyses performed.

RESULTS:

All MSCs demonstrated chondrogenic and osteogenic differentiation potentials in vitro. In correction of varus angulation groups I and II exhibited superior results when compared to group III (P<0.05). The length discrepancies between operated and normal tibiae in groups I, II and III were significantly corrected when compared to the control group (P<0.01).

CONCLUSION:

In conclusion bone marrow and periosteum derived stem cells provided better correction of physeal arrest in rabbits. The source of MSCs itself could influence the success in the treatment of growth arrest.
OBJECTIVE:

Low BMD in a well aligned knee could suggest underlying osteoporosis which could lead to insufficiency fracture. We have established a protocol to measure the subchondral tibial BMD with good precision. The aim of this study was to compare the baseline BMD in the medial and lateral compartment of the knee in pre and post-menopausal women.

METHODOLOGY:

BMD of both hips and knees were measured. X-rays of both knees were taken to ascertain that the subjects had normal knee joints. Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ). The activity levels were categorized as low, moderate or high.

RESULTS:

In pre-menopausal women (n=77, mean age = 45.9 ± 1.1 years), the mean medial and lateral BMD was 0.80 ± 0.110 g/cm² and 0.78 ± 0.115 g/cm² respectively. In postmenopausal women (n= 66, mean age = 56.7 ± 1.73 years), the mean medial and lateral BMD was significantly lower, i.e. 0.685 ± 0.105 g/cm² and 0.660 ± 0.090 g/cm² respectively. Medial to lateral BMD ratio in both knees were similar in the two groups. There was a significant correlation between medial and lateral knee BMD and femoral neck BMD (p < 0.01). The femoral neck BMD was significantly lower in post-menopausal women, i.e. 0.735 ± 0.090 g/cm², as compared to pre-menopausal women (mean hip BMD = 0.830 ± 0.100 g/cm²). 63.6% post-menopausal women had osteopenia in the hip.

CONCLUSION:

More than 80% of both pre and post-menopausal women had moderate to high levels of physical activity. However, there was no correlation of baseline knee and femoral neck BMD to the level of physical activity. Longitudinal BMD measurements will be done and compared to the baseline values and physical activity in the two groups in future studies.
OBJECTIVE:

Fibre-based scaffolds have been widely used for tendon and ligament tissue engineering. Knitted scaffolds have been proved to favour collagenous matrix deposition which is crucial for tendon/ligament reconstruction. However, such scaffolds have the limitation of being dependent on a gel system for cell-seeding, which is unstable in a dynamic environment like the knee joint. This study developed three types of hybrid scaffolds, based on knitted biodegradable polyester scaffolds, aiming to improve mechanical properties and cell attachment and proliferation on the scaffolds.

METHODOLOGY:

The hybrid scaffolds were created by coating the knitted scaffolds with a thin film of poly (ε-caprolactone) (Group I), poly (D,L-lactide–co–glycolide) nanofibres (Group II) and type 1 collagen (Group III). Woven scaffolds were also fabricated and compared with the various hybrid scaffolds in terms of their mechanical properties during in vitro degradation and cell attachment and growth.

RESULTS AND CONCLUSION:

This study demonstrated that the coating techniques could modulate the mechanical properties and facilitate cell attachment and proliferation in the hybrid scaffold which could be applied with promise in tissue engineering of tendon/ligament.
OBJECTIVE:

Biomechanical properties of skin are important for clinical decision making as well as clinical intervention. Measuring these properties in vivo is critical for estimating dimensional behaviour of skin flap or graft after harvest. However, existing methodologies and devices often suffer from lack of standardisation and unwanted peripheral force contribution due to the deformation of surrounding tissues during measurement. This naturally leads to measurement inaccuracies and lack of reproducibility.

METHODOLOGY:

In order to improve the measurement accuracy, a new portable extensometer, which measures the non-invasive in vivo biomechanical properties of skin, has been designed and constructed. This design incorporates three pads that attach to the skin, including a C-shaped pad to shield the force sensor from peripheral forces. Such design produces data that are significantly closer to in vitro measurements.

RESULTS:

The results have been verified by finite element analysis, and experiments on rubber sheets and pig skins.

CONCLUSION:

This device can be used to obtain biomechanical properties of skin that will aid doctors in measuring skin elasticity and surgical planning, especially in skin flap surgery.
**OBJECTIVE:**

Difficulties are faced by many prosthetists in consistently producing satisfactory socket fit. Some major causes arise from inadequate training and experience of the prosthetics in the patellar-tendon-bearing (PTB) socket technique. In 1965, Murdoch introduced a pressure casting concept where fluid was used to apply uniform pressure around the stump, which produced the Dundee socket. However, an indentation to the patellar tendon was implemented. Kristiansen used the same pressure casting concept by using air as a medium in the Icelandic Roll on Silicone Socket (ICEROSS) system. Rectifications were done by adding padding over bony areas of the stump during the casting process in a non-weight bearing fashion i.e. not standing. The theory supporting these various attempts in pressure casting technique is known as Pascal’s principle of fluid mechanics.

**METHODOLOGY:**

Using similar pressure casting technique, a pressure cast (Past) system was developed. Furthermore, this socket would be fabricated using braided carbon fiber which is a quick curing material, instead of the traditional lamination method. This would reduce a three-stage fabrication process to a one-stage process. The carbon braids were impregnated with resins and draped onto the stump. The stump was then inserted into the Past tank. When level standing was ensured, pressure was introduced to the system. When the drape was fully cured and hardened, it was removed from the stump and was used to form the final socket. This system produces a Direct Pressure Cast (Ducats) socket without any rectifications. This socket was successfully fitted onto 10 subjects.

**RESULTS:**

Preliminary gait studies showed that there were no significant differences between the subjects’ original socket and the Ducats socket. Therefore, this technique has enabled the fabrication of a comfortable-fitting socket.

**CONCLUSION:**

The main advantages in using this technique are the removal of all manual dexterity and inter-prosthetics variances.
OBJECTIVE:

To investigate the mechanical properties and morphological characteristics of articular cartilage on the tibial plateau of human knees, including the region covered by the meniscus.

METHODOLOGY:

Using a 1-mm diameter flat-ended cylindrical probe to apply a constant load (0.6 MPa) at specific sites on the tibial plateau, the mechanical properties of articular cartilage were studied using seven cadaver knees. Comparison was made between data obtained by the cartilage covered by the meniscus and that not covered. This was done for both the medial and lateral plateaus. Histological sections of the articular cartilage were also performed to study differences between cartilage from these regions of the tibial plateau.

RESULTS:

Compared to cartilage that was not covered by the meniscus, the articular cartilage beneath the meniscus showed a significantly ($P < 0.05$) larger modulus by as much as 70%, and was less thick by about 40%. Also, the subchondral bone quantity and calcified layer thickness were observed to be significantly lesser in the regions covered by the meniscus.

CONCLUSION:

Our findings revealed a significant difference between the mechanical properties and associated structures of articular cartilage in the region covered by the meniscus compared with the articular cartilage not covered by the meniscus.
Measurement of tibial subchondral BMD in the knee using DXA

Low Siew Leng, Shamal Das De, Wilson Wang, K Satku

OBJECTIVE:
The aim of this study is to validate a technique to measure tibial subchondral BMD in normal and OA knees using dual energy X-ray absorptiometry (DXA).

METHODOLOGY:
30 subjects were scanned using a NORLAND XR-36 DXA scanner. The knee to be scanned was positioned with the patella facing upwards. To determine the intra-operator error in positioning, 5 subjects were scanned 3 times each, with re-positioning of the knee after each scan. Regions of interest (ROI) were placed in the lateral and medial compartments of the tibial subchondral bone. Medial and lateral ROI were determined by measuring a distance 10 mm distal to the tip of the tibial spine, which was used as a reference point. The height of each ROI was 5.0 mm and is defined within two rectangles either medially or laterally to the edge of the image. To determine the inter-operator variation in the placement of the ROIs, 3 operators independently analysed both knees of 14 subjects with normal knees and the unaffected knee of 16 subjects with OA knee.

RESULTS:
The precision of the intra-operator positioning was 2.2% for the medial ROI and 1.6% for the lateral ROI in normal knees. In OA knees, the precision error increased to 3.8% and 2.0% in the medial and lateral ROI respectively.

CONCLUSION:
DXA is a reliable technique which can measure subchondral tibial BMD with good precision. This method may be used to prospectively monitor the progression of knee OA.
Young Investigator’s Award, National Healthcare Group Annual Scientific Congress 2004

The impact of microanastomosis of the intramuscular nerve branch on the healing of a completely lacerated skeletal muscle: A histopathological analysis

Zheng Ling, Jessie Tan Ai Cheng, Tan Bee Leng, Barry Pereira, Aymeric Lim Yu Tang, Amitabha Lahiri, VP Kumar

OBJECTIVE:

Lacerated muscles often do not fully recover its function and strength. Various biological approaches have been used to enhance muscle regeneration and reduce fibrosis formation, yet recovery is still incomplete. This study assesses the impact on the muscle recovery with the introduction of intramuscular (IM) nerve repair by surgical microanastomosis when repairing complete lacerated muscles.

METHODOLOGY:

A through-thickness laceration in the medial gastrocnemius (MG) muscles in adult NZ White rabbits were modelled where subsequently two different repairs were assessed: Group 1: immediate muscle repair only and Group 2: microanastomosis of the main IM nerve branch followed by an immediate muscle repair. The study hypothesized that the repaired intramuscular nerve branch would influence an improved recovery of the lacerated muscle. A control muscle repair model involved one that was lacerated but with the IM nerve preserved intact (Group 3). The contralateral muscles also serve as controls.

RESULTS:

Innervation, muscle regeneration, fibrosis formation and myosin isoform composition were analyzed using acetylcholinesterase (AchE) at 7-month. In Group 2 compared to Group 1, further improvement in the healing of muscle laceration was attained histologically, with enhanced muscle regeneration and reduced fibrosis formation. Yet, this was still not as good when compared Group 3, although morphologic appearance and myosin isoform composition were not significantly different between Groups 2 and 3. At 7-months, AchE staining demonstrated improved reinnervation in Group 2 yet still not as good as in Group 3, where the nerve was preserved intact.

CONCLUSION:

This study demonstrates the effectiveness of the microanastomosis of main IM nerve branch in the recovery of lacerated muscles, and provides a rationale to improve the recovery.
Strain rate effect on the failure properties of tendons

BH Ng, SM Chou, Lim Beng Hai and Alphonsus Chong

OBJECTIVE:
The purpose of this study is to evaluate the effect of strain rate on the failure properties of tendons.

METHODOLOGY:
Seventy-five chicken flexor digitorum profundus (FDP) tendons were tensile tested at 15 strain rates, ranging from 0.05 to 150 per cent/s.

RESULTS:
Results showed that strain rate had little effect on the shape of the stress-strain curve. No significant change was observed in the toe region, while the slope of the linear region increased with the increase in strain rate. Generally, the ultimate tensile strength (UTS) and elastic modulus increased significantly as strain rate increased (p < 0.01), while no significant change in strain at UTS (p>0.01) was observed.

CONCLUSION:
It was found the change in failure properties of tendons was not significant, with small change in strain rate.
OBJECTIVE:

Loss of the meniscus leads to abnormal load transmission across the knee joint. Thus there is a current move toward meniscus preservation. Traditionally, meniscal tears in the avascular zone have been treated with partial meniscectomy due to poor repair potential. Our study investigates the use of mesenchymal stem cells to enhance the repair of meniscal tears in the avascular zone in a porcine model.

METHODOLOGY:

The vascular supply of the porcine meniscus was defined using microangiography barium sulphate. This was compared to the human vascular pattern. 26 adult pigs (52 knees) underwent meniscal procedures. Autologous adult mesenchymal stem cells were harvested from the iliac bone of each pig. Then the control group 1 had a meniscal radial tear created and left untreated. Control group 2 had the meniscal tear repaired with suture and fibrin glue. The experimental group had the tear treated with mesenchymal stem cells, suture and fibrin glue. At 8 weeks the menisci were harvested. The tear was examined grossly and histologically under light microscopy. The repair strength was also biomechanically tested with the Instron machine. The mesenchymal stem cells were labeled with green fluorescent protein and examined with the confocal microscope.

RESULTS:

The pattern of vascular supply of the porcine meniscus was confirmed to be similar to that seen in humans. Gross examination of control group 1 revealed no healing in all specimens. Control group 2 had 5 incomplete healing and 11 specimens with no healing. The experimental group had 19 specimens which showed complete healing, 5 specimens incomplete healing and 1 specimen with no healing. Histological examination of the experimental group revealed healing with fibrocartilage-like tissue. The experimental group also had a stronger biomechanical repair. Confocal microscope examination demonstrated the presence of introduced mesenchymal stem cells within the repair which was seen with green fluorescence.

CONCLUSION:

Repair of meniscal tears in the avascular zone has been shown to be improved with mesenchymal stem cells in the porcine model. If these results can be reproduced in clinical trials, then meniscus preservation would be achieved. This would maintain normal knee joint biomechanics and possibly retard the development of osteoarthritis.
Young Doctor Award, 7th NUS-NUH Annual Scientific Meeting, Singapore, 2-3 Oct 2003

A comparative study of efficacy of mesenchymal stem cells (MSC) from bone marrow, periosteum and fat transfers in the treatment of partial growth arrest

Teo Yee Hong, Li Li, James Hui Hoi Po, Lee Eng Hin

OBJECTIVE:

To evaluate the efficacy of MSCs from bone marrow, periosteum, and fat in treatment of partial growth arrest. In-vitro lineage differentiation was investigated and rabbit model was created.

METHODOLOGY:

MSCs from bone marrow, periosteum, and adipose were harvested and cultured. Various biological factors were used to induce chondrogenic and osteogenic differentiation. Calcium, alkaline phosphatase activity, collagen II content was examined and compared. Medial half, proximal physis of tibiae in 6 week old NZW rabbits were excised in our model. Cultured MSCs with fibrin glue (carrier) were transferred into the growth plate defect following excision of bony bridge in established growth arrest. Contralateral tibiae received fibrin glue only as controls. 3 experimental groups of rabbits were established based on MSCs source and were sacrificed at 8 and 16 weeks post-operatively. Clinical, radiological and histological analysis was performed.

RESULTS:

All MSCs demonstrated potential chondrogenic and osteogenic lineage differentiation ability. The proliferative rates were similar at day 4, 7 and 11. MSCs derived from bone marrow and periosteum appeared more homogenous than from fat. All the tibiae treated with MSCs from bone marrow and periosteum showed significant correction of varus deformity at 16 weeks. However, the varus angulation remained at 5.8º in fat group. The limb difference with contralateral limb (control) in each animal was 0.65 ± 0.33 cm (bone marrow), 0.68 ± 0.24 cm (periosteum) and 1.22 ± 0.43 cm (adipose).

CONCLUSION:

Bone marrow and periosteum MSCs better correct physeal arrest in rabbit, hence the source of MSC does influence the success of treatment.
Enhancement of tendon graft osteointegration using mesenchymal stem cells in a rabbit model of anterior cruciate ligament reconstruction

Lim Jit Kheng, Li Li, Chong Sue Wee, Julee Chan, Ashvin Thambyah, James Goh, Lee Eng Hin

OBJECTIVE:

Mesenchymal stem cells (MSCs) are under investigation as potential agents to enhance bone and cartilage healing in a variety of orthopaedic disorders. We hypothesized that the application of MSCs at the tendon-bone junction during ACL reconstruction might result in both acceleration and enhancement of osteointegration of the tendon graft to the bone tunnel.

METHODOLOGY:

Bilateral ACL reconstructions with hamstring tendon autografts were performed in 30 adult rabbits. The graft was coated with allogenous MSCs in a fibrin glue carrier in one limb, while the contralateral limb served as control with no application of MSCs. The reconstructions were assessed at 2, 4 and 8 weeks. Histological analysis was performed using hematoxylin/eosin and safranin-O staining. Biomechanical testing of the ACL grafts for stress, strain and elastic modulus was performed with cyclical loading followed by load-to-failure.

RESULTS:

Histologic analysis of controls revealed fibroblasts and granulation tissue with development of some collagen fibres resembling Sharpey's fibres by 8 weeks. The tendon-bone interfaces of the MSC enhanced reconstructions, consistently demonstrated large areas of fibrocartilage between tendon and bone as early as 4 weeks. On biomechanical testing, the MSC enhanced grafts had significantly higher load-to-failure than did controls at all time frames.

CONCLUSION:

The application of mesenchymal stem cells at the tendon-bone interface during ACL reconstruction results in the development of an intervening zone of fibrocartilage (resembling the chondral enthesis of normal ACL insertions) rather than collagen fibres and scar tissue. The resultant ACL reconstructions perform significantly better on biomechanical testing. The use of MSCs to enhance tendon graft osteointegration is a novel method offering the potential of more physiological, earlier healing and biomechanically stronger ligament reconstructions.
OBJECTIVE:

The purpose of this study was to evaluate the pressure distribution at the stump/socket interface in amputees wearing the patellar-tendon-bearing socket.

METHODOLOGY:

A specially built strain gauged type pressure transducer was used for measuring this pressure distribution in four unilateral transtibial amputees. Pressure and gait parameters were measured simultaneously while they were standing and walking. Pressure profiles were compiled at 10, 25 and 50 per cent of gait cycle and compared with the pressure profiles predicted by Radcliffe in 1961.

RESULTS:

The subject’s anterior–posterior pressure profiles were different from each other. However, at toe-off, each subject exhibited an increase in pressure at the patellar tendon. Their medial–lateral pressure profiles were similar: exhibiting high pressure at the medial proximal and lateral distal regions except for one subject who exhibited high pressure at the lateral proximal region instead.

CONCLUSION:

The subjects’ pressure profiles did not resemble Radcliffe’s anticipated pressure profiles. This was because ground reaction force was not the only factor affecting the resulting pressure profiles.
ABSTRACTS OF TOP 3 PUBLICATIONS (2001 - 2011)
OBJECTIVE:
Nondegradable cages have been used for interbody fusion with good results. However, the overall advantage of lifelong implantation of a nondegradable device remains a subject of ongoing debate. The use of bioresorbable scaffolds might offer superior alternatives. In this study, we evaluated the quality of fusion obtained with two potential bone graft substitutes. We aim to compare the quality of fusion resulting from implantation of medical grade poly (ε-caprolactone)-20% tricalcium phosphate (mPCL/TCP) scaffolds and two different bone growth stimulating agents.

METHODOLOGY:
A large animal study comparing interbody fusion of a bioresorbable scaffold loaded with either low-dose recombinant human bone morphogenetic protein 2 (rhBMP-2) or bone marrow-derived multipotent stromal cells (BMSCs) was performed. Eleven Yorkshire pigs underwent a bisegmental (L2/L3; L4/L5) anterior lumbar interbody fusion (ALIF) in four groups, namely: (1) mPCL/TCP + 0.6 mg rhBMP-2; (2) mPCL/TCP + BMSCs; (3) mPCL/TCP (negative control); and (4) autologous bone grafts (positive control).

RESULTS:
The mean radiographic scores at 9 months were 3.0, 1.7, 1.0, and 1.8 for groups 1 to 4, respectively. The bone volume fraction of group 1 was two-folds higher than group 2. Histology, micro-computed tomographic scanning and biomechanical evaluation demonstrated solid and comparable fusion between groups 1 and 4. However, group 2 showed inferior quality of fusion when compared with groups 1 and 4 while group 3 showed no fusion even at 9 months. In addition, there was no evidence of implant rejection, chronic inflammation or any other complications.

CONCLUSION:
mPCL/TCP scaffolds loaded with low-dose rhBMP-2 is comparable to autograft bone as a bone graft substitute in this large animal ALIF model. Although BMSCs lagged behind autograft bone and rhBMP-2, evidence of bone ingrowth in this group warrants further investigation. Our results suggest that mPCL/TCP scaffolds loaded with rhBMP-2 or BMSCs may be a viable alternative to conventional cages and autograft bone.

PMID: 21673630

Idiopathic Scoliosis In Singapore Schoolchildren: A Prevalence Study 15 Years Into The Screening Program

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OBJECTIVE:
Prevalence rates for idiopathic scoliosis of 5 degrees or more in schoolchildren were established in a study performed in 1982. There have been no previous data on prevalence rate changes over time. We aim to determine the prevalence rates of idiopathic scoliosis and to compare with a previous prevalence study done 15 years earlier.

METHODOLOGY:
A point prevalence survey of 72,699 schoolchildren in four age groups was performed. A total of 35,558 boys and 37,141 girls from randomly selected schools were screened for scoliosis. Those with scoliometer readings of more than 5 degrees underwent radiographic evaluation. Prevalence rates were calculated for scoliosis at a predefined Cobb angle of 10 degrees and 5 degrees, the latter for comparison with the previous prevalence study. Curve type and distribution, pubertal status, and symptoms were correlated with the prevalence data.

RESULTS:
Prevalence rates were 0.05% for girls and 0.02% for boys at 6 to 7 years of age, 0.24% for girls and 0.15% for boys at 9 to 10 years of age, 1.37% for girls and 0.21% for boys at 11 to 12 years of age, and 2.22% and 0.66%, respectively, for girls and boys at 13 to 14 years of age. The ratio of girls to boys increased from 1.6 at 9 to 10 years of age to 6.4 at 11 to 12 years of age. Thoracolumbar curves were the most common (40.1%), followed by thoracic curves (33.3%), double/triple curves (18.7%), and lumbar curves (7.9%). Older children had greater proportions of larger curves. Compared with the previous prevalence study in 1982, there was a significant increase in the prevalence rate in girls 11 to 12 years of age. Screening of 11- to 12- and 13- to 14-year-old girls detected curves in the range suitable for bracing, with nearly 96% and 32% of the age groups, respectively, still amenarche or within a year of menarche, and 57% and 34% of the age groups, respectively, having low Risser grades of 0, 1, and 2.

CONCLUSION:
The overall prevalence rate of idiopathic scoliosis in our school population in 1997 was 0.93% in girls and 0.25% in boys. The prevalence rates were low at 6 to 7 and 9 to 10 years of age but increased rapidly to 1.37% and 2.22% for girls at 11 to 12 and 13 to 14 years of age, respectively. The prevalence rate increased significantly in 11- to 12-year-old girls over a 15-year period from 1982 to 1997. Screening of 11- to 12- and 13- to 14-year-old girls identified a significant number who could benefit from brace treatment.

PMID: 15897834
Osteosarcomas are the most prevalent primary bone tumors found in pediatric patients. To understand their molecular etiology, cell culture models are used to define disease mechanisms under controlled conditions. Many osteosarcoma cell lines (e.g., SAOS-2, U2OS, MG63) are derived from Caucasian patients. However, patients exhibit individual and ethnic differences in their responsiveness to irradiation and chemotherapy. This motivated the establishment of osteosarcoma cell lines (OS1, OS2, OS3) from three ethnically Chinese patients. OS1 cells, derived from a pre-chemotherapeutic tumor in the femur of a 6-year-old female, were examined for molecular markers characteristic for osteoblasts, stem cells, and cell cycle control by immunohistochemistry, reverse transcriptase-PCR, Western blotting and flow cytometry. OS1 have aberrant G-banded karyotypes, possibly reflecting chromosomal abnormalities related to p53 deficiency. OS1 had ossification profiles similar to human fetal osteoblasts rather than SAOS-2 which ossifies ab initio (P < 0.05). Absence of p53 correlates with increased Runx2 expression, while the slow proliferation of OS1 cells is perhaps attenuated by pRB retention. OS1 express mesenchymal stem cell markers (CD44, CD105) and differ in relative expression of CD29, CD63, and CD71 to SAOS-2. (P < 0.05). Cell cycle synchronization with nocodazole did not affect Runx2 and CDK1 levels but decreased cyclin-E and increased cyclin-A (P < 0.05). Xenotransplantation of OS1 in SCID mice yields spontaneous tumors that were larger and grew faster than SAOS-2 transplants. Hence, OS1 is a new osteosarcoma cell culture model derived from a pre-chemotherapeutic ethnic Chinese patient, for mechanistic studies and development of therapeutic strategies to counteract metastasis and deregulation of mesenchymal development.

PMID: 19746444
Innervation Of The Face Studied Using Modifications To Sihler’s Technique In A Primate Model

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OBJECTIVE:

There has been no reliable technique with which to display the innervation within whole-tissue specimens of the face. Such a technique preserves the architecture of the facial muscles and provides new data on intramuscular and sensory neural networks. Sihler’s technique preferentially stains myelinated nerves within whole tissue, which is rendered transparent. On transillumination, entire neural networks can be studied in situ without the need for dissection and histologic examination. The purpose of this study was to apply Sihler’s technique to study innervation patterns of the face, define end points, and improve specimen transillumination.

METHODOLOGY:

Eight macaque fascicularis monkeys were studied. The mimetic muscles of the face with intact facial nerve and sensory nerves were harvested as whole tissue composites. Sihler’s technique was modified with formalin fixation before dissection to minimize autolysis of the myelin sheath. Prolonged immersion in glycerin improved tissue transparency. A replica of the skull was made with silicone and a light source embedded to restore three-dimensional configuration and provide transillumination.

RESULTS:

The facial nerve and sensory nerves were clearly seen up to their terminations in the transparent muscle and soft tissue. Observations were made with regard to the extramuscular and intramuscular innervation patterns of the facial nerve and sensory nerve patterns.

CONCLUSION:

Sihler’s technique is a simple and reliable method with which to study the innervation of the face. This process may be applied to the human face to provide a much-needed roadmap to surgery, and the primate model may be developed for the study of facial reinnervation, facial reanimation, and dynamic facial transplantation.

PMID: 18349636
The Natural History Of Spontaneous Osteonecrosis Of The Medial Tibial Plateau

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OBJECTIVE:
The natural history of spontaneous osteonecrosis of the medial tibial plateau remains controversial and incomplete.

METHODOLOGY:
We have studied 21 patients (aged between 53 and 77 years) with clinical and scintigraphic features of spontaneous osteonecrosis of the medial tibial plateau who were observed prospectively for at least three years (37 months to 8.5 years).

RESULTS:
The mean duration of follow-up was 5.6 years. The mean duration of symptoms at presentation was 4.7 weeks (3 days to 12 weeks). Radiographs of the affected knee at the first visit were normal in 15 patients and mildly arthritic in six. The characteristic radiographic lesion of osteonecrosis was noted at presentation in five of the mildly arthritic knees and during the evolution of the disease in eight of the radiographically normal knees. During the follow-up, subchondral sclerosis of the affected medial tibial plateau was noted in 16 knees. There are three distinct patterns of outcome: 1) acute extensive collapse of the medial tibial plateau in two knees within three months of onset; 2) rapid progression to varying degrees of osteoarthritis in 12 knees, in eight within a year, in all within two years and deterioration of the pre-existing osteoarthritis in three; and 3) complete resolution in four knees, two of which were normal at presentation and two mildly osteoarthritic. The two patients with acute extensive collapse and three who had rapid progression to severe osteoarthritis required total knee arthroplasty.

CONCLUSION:
We conclude that osteonecrosis of the medial tibial plateau progresses in most cases to significant degenerative disease of the knee.

PMID: 14516032
Inaugural Lecture Of The College Of Surgeons, Singapore: Of Role And Role Model (A College Takes its First Steps Towards Collective And Individual Excellence In The 21st Century)

Satku K, Lo TJ.
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EXCERPT FROM SPEECH:

“The Chapter of Surgeons was formed in 1966. It came under the umbrella of the Academy of Medicine. But over the nearly 40 years, we have realised that the Chapter, with its 9 specialties, very much like the Chapter of Physicians with its 15 specialties, should be given more space and latitude to grow and develop.

The idea of having distinct Colleges for each of the different major specialties was mooted some 10 years ago. When I was the Master of the Academy of Medicine, the Council and I were tasked to deliver the Colleges. We believed that the establishment of Colleges would not only allow more space and latitude for the growth of the individual disciplines, but also allow more colleagues to be involved in professional issues and take leadership positions. So we worked tirelessly for the establishment of the Colleges. I am glad that this vision of the many Masters and Councils has come to fruition with the establishment of the Colleges last year. Each one of us was involved in this decision. It is now time for us to reflect and ponder on our role.

If we can define the role of the College and the role of the profession, our roles as individuals will become clear. It is only through such reflection that we can steer our College and position it to serve the profession, our people and the nation.

I believe that one of the primary roles of the College is to develop and sustain professionalism. Our nation today enjoys high medical standards and a reputation for ethical practice and the College should ensure that neither is ever compromised. In this context, the College must set standards for the practice of surgery, put in place processes to ensure that these standards are safeguarded, set directions for growth, promote collegiality, train the next generation of surgeons, be an inspiration to its Fellows and be the pride of our nation.”

PMID: 16453043
Transformation of Adult Mesenchymal Stem Cells Isolated From the Fatty Tissue Into Cardiomyocytes

Sunil, Rangappa, Fen Chen, E H Lee, T A Bongso and E K W Sim

OBJECTIVE:
Myocardial infarction results in the death of cardiomyocytes, which are replaced by scar tissue. Cardiomyocytes cannot regenerate because they are terminally differentiated. Mesenchymal cells are pluripotent cells, which have the potential to differentiate to specialized tissues under appropriate stimuli. The aim of this study was to direct differentiation of the adult mesenchymal stem cells isolated from fatty tissue into cardiomyocytes using 5-azacytidine.

METHODOLOGY:
Adult mesenchymal stem cells were isolated from the fatty tissue of New Zealand White rabbits and cultured in RPMI medium. Second-passaged mesenchymal cells were treated with various concentrations of 5-azacytidine and incubated for different intervals of time. The cells were plated in six-well dishes at 500, 5,000, and 50,000 cells/well. These cells were treated with 1-, 3-, 6-, 9-, and 12-micromol/L concentrations of 5-azacytidine and incubated for 12, 24, 48, and 72 hours. Later, the medium was replaced with fresh medium and incubated in a CO2 incubator. The medium was changed once at 3 to 4 days. At 2 months, the cells were fixed with 0.4% glutaraldehyde for 2 hours and later washed with phosphate-buffered saline. The transformed cells were subjected to immunostaining for the myosin heavy chain, alpha actinin, and troponin-I.

RESULTS:
After treatment with 5-azacytidine, the adult mesenchymal stem cells were transformed into cardiomyocytes. At 1 week, some cells showed binucleation and extended cytoplasmic processes with adjacent cells. At 2 weeks, 20% to 30% of the cells increased in size and formed a ball-like appearance. At 3 weeks, these cells began to beat spontaneously in culture when observed under phase contrast microscope. Immunostaining of the transformed cells for myosin heavy chain, alpha actinin, and troponin-I was positive. The differentiated cells maintained the phenotype and did not dedifferentiate up to 2 months after treatment with 5-azacytidine.

CONCLUSION:
These observations confirm that adult mesenchymal stem cells isolated from fatty tissue can be chemically transformed into cardiomyocytes. This can potentially be a source of autologous cells for myocardial repair.
Identification Of Common Pathways Mediating Differentiation Of Bone Marrow- And Adipose Tissue-Derived Human Mesenchymal Stem Cells Into Three Mesenchymal Lineages

Liu TM, Martina M, Hutmacher DW, Hui JH, Lee EH, Lim B.

Mesenchymal stem cells derived from human bone marrow (hBMSCs) and human adipose tissue (hAMSCs) represent a useful source of progenitor cells for cell therapy and tissue engineering. However, it is not clear what the similarities and differences between them are. Like hBMSCs, hAMSCs can differentiate into osteogenic, adipogenic, and chondrogenic cells. Whether MSCs derived from different tissue sources represent fundamentally similar or different cell types is not clear. Given the possible different sources of MSCs for cell therapy, a comprehensive comparison of the different MSCs would be very useful. Here, we compared the transcriptome profile of hAMCS and hBMSCs during directed differentiation into bone, cartilage, and fat. Our data revealed considerable similarities between bone marrow-derived MSCs (BMSCs) and adipose tissue-derived MSCs (AMSCs). We uncovered an interesting bifurcation of pathways in both BMSCs and AMSCs, in which osteogenesis and adipogenesis appear to be linked in a differentiation branch separate from chondrogenesis. Our data suggest that although a set of common genes may be needed for early differentiation into all three lineages, a different set of signature genes is associated with maturation into fully differentiated cells. The recruitment of different late differentiation factors explains and supports our conclusion that BMSCs differentiate more efficiently into bone and cartilage, whereas AMSCs differentiate better into adipocytes. This study not only generated a rich database for continuing molecular characterization of various MSCs but also provided a rational basis for assessing qualities of MSCs from different sources for the purpose of cell-based therapy and tissue engineering.

PMID: 17095706

Directing Stem Cell Differentiation Into The Chondrogenic Lineage In Vitro

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A major area in regenerative medicine is the application of stem cells in cartilage tissue engineering and reconstructive surgery. This requires well-defined and efficient protocols for directing the differentiation of stem cells into the chondrogenic lineage, followed by their selective purification and proliferation in vitro. The development of such protocols would reduce the likelihood of spontaneous differentiation of stem cells into divergent lineages upon transplantation, as well as reduce the risk of teratoma formation in the case of embryonic stem cells. Additionally, such protocols could provide useful in vitro models for studying chondrogenesis and cartilaginous tissue biology. The development of pharmacokinetic and cytotoxicity/genotoxicity screening tests for cartilage-related biomaterials and drugs could also utilize protocols developed for the chondrogenic differentiation of stem cells. Hence, this review critically examines the various strategies that could be used to direct the differentiation of stem cells into the chondrogenic lineage in vitro.

PMID: 15579636
**Ibandronate Does Not Reduce The Anabolic Effects Of PTH In Ovariectomized Rat Tibiae: A Microarchitectural And Mechanical Study**

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**OBJECTIVE:**

Osteoporosis remains a challenging problem. Understanding the regulation on osteoclast and osteoblast by drugs has been of great interest. Both anabolic and anti-resorptive drugs yield positive results in the treatment of osteoporosis. However, whether the concurrent administration of parathyroid hormone (1-34) and ibandronate may offer an advantage over monotherapy is still unknown. This study, therefore, attempts to compare the efficacy of two therapeutical approaches and to investigate the beneficial effects in concurrent therapy in a rat model using three-point bending, pQCT and μCT analysis.

**METHODOLOGY:**

A total of 60 female Sprague-Dawley rats of age 10 to 12 weeks were divided into 5 groups (SHAM, OVX+VEH, OVX+PTH, OVX+IBAN, OVX+PTH+IBAN) and subjected to ovariectomy or sham surgery accordingly. Low-dose parathyroid hormone (PTH) and/or ibandronate or its vehicle were administered subcutaneously to the respective groups starting from 4th week post-surgery at weekly intervals. Three rats from each group were euthanized every 2 weeks and their tibiae were harvested. The tibiae were subjected to metaphyseal three-point bending, pQCT and μCT analysis. Serum biomarkers for both bone formation (P1NP) and resorption (CTX) were studied.

**RESULTS AND CONCLUSION:**

A total of 11 indices showed a significant difference between SHAM and OVX+VEH groups, suggesting the successful establishment of osteoporosis in the rat model. Compared to the previous studies which showed impedance from bisphosphonates in combination therapy with PTH, our study revealed that ibandronate does not block the anabolic effects of PTH in ovariectomized rat tibiae. Maximum load, strength-strain indices and serum bone formation markers of OVX+PTH+IBAN group are significantly higher than both monotherapy groups. With the proper ratio of anabolic and anti-resorptive drugs, the effect could be more pronounced.

PMID: 21334474
A Rational Approach To Management Of Alendronate-Related Subtrochanteric Fractures

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OBJECTIVE:
There have been recent reports linking alendronate and a specific pattern of subtrochanteric insufficiency fracture.

METHODOLOGY:
We performed a retrospective review of all subtrochanteric fractures admitted to our institution between 2001 and 2007. There were 20 patients who met the inclusion criteria, 12 of whom were on long-term alendronate.

RESULTS:
Alendronate-associated fractures tend to be bilateral (Fisher’s exact test, p = 0.018), have unique radiological features (p < 0.0005), be associated radiologically with a pre-existing ellipsoid thickening of the lateral femoral cortex and are likely to be preceded by prodromal pain. Biomechanical investigations did not suggest overt metabolic bone disease. Only one patient on alendronate had osteoporosis prior to the start of therapy.

CONCLUSION:
We used these findings to develop a management protocol to optimise fracture healing. We also advocate careful surveillance in individuals at-risk, and present our experience with screening and prophylactic fixation in selected patients.

PMID: 20436006
The Susceptibility Of The Femoral Neck To Fracture: An Assessment Incorporating The Effects Of Age-Remodeling And Stress Reduction

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OBJECTIVE:

Age-related bone remodeling may cause fragility of the femoral neck, thereby increasing fracture risk in elderly populations. We investigated the effects of age-remodeling and stress-reduction on the femoral neck region using the Finite Strip Method (FSM). We verified the possibility that the femoral neck is likely to undergo fracture through two mechanisms: yielding and local buckling. We hypothesized that the femoral necks of young subjects are more prone to fracture by yielding, whereas those of elderly subjects are more susceptible to fracture initiated by local buckling.

METHODOLOGY:

The slices from the CT-scans of 15 subjects corresponding to the lowest area moment of inertia were segregated into cortex and trabeculae. Geometric and material properties for each strip were obtained from the CT-scans. The FSM, proposed here as an approximation to the better-known Finite Element Method (FEM), was implemented on a model comprising both cortex and trabeculae. Finite strip (FS) analyses were performed on models that incorporated the effects of age-related bone remodeling, as well as a reduction in physiological stress on the bone (as a result of weight loss). Comparisons were made with similar FS analyses performed on only the cortical shell, in order to ascertain the contributions of the trabeculae to femoral neck strength.

RESULTS AND CONCLUSION:

We observed that the femoral necks of simulated young subjects manifested a marked predisposition to undergo yielding, whereas the femoral neck models of simulated elderly subjects were more prone to buckling before yielding. The trabecular degradation and cortical thinning involved in aging render the femoral neck more susceptible to failure by buckling.

PMID: 22326126
Compartment syndrome of the foot requires urgent surgical treatment. Currently, there is still no agreement on the number and location of the myofascial compartments of the foot. The aim of this cadaver study was to provide an anatomical basis for surgical decompression in the event of compartment syndrome. We found that there were three tough vertical fascial septae that extended from the hindfoot to the midfoot on the plantar aspect of the foot. These septae separated the posterior half of the foot into three compartments. The medial compartment containing the abductor hallucis was surrounded medially by skin and subcutaneous fat and laterally by the medial septum. The intermediate compartment, containing the flexor digitorum brevis and the quadratus plantae more deeply, was surrounded by the medial septum medially, the intermediate septum laterally and the main plantar aponeurosis on its plantar aspect. The lateral compartment containing the abductor digitii minimi was surrounded medially by the intermediate septum, laterally by the lateral septum and on its plantar aspect by the lateral band of the main plantar aponeurosis. No distinct myofascial compartments exist in the forefoot. Based on our findings, in theory, fasciotomy of the hindfoot compartments through a modified medial incision would be sufficient to decompress the foot.

PMID: 18669973

The organization of the microvasculature of the dorsal human fingertip based on a vascular corrosion cast was examined using a stereoscopic microscope. The variations of the superficial capillary network of the 3 specialized areas of skin of the dorsal fingertip (the nail bed, the nail matrix, and the nail fold) are described. In the nail bed numerous capillary loops were observed arising from a deeper regular arrangement of sagittally aligned, parallel rows of vessels. The size and direction of inclination of the capillary loops varied, getting longer and more inclined to the nail bed distally, with the longest capillary loops seen at the hyponychium. There were no capillary loops at the nail matrix region, but there was a single, layered, rectangular plexus of capillaries in the plane of the nail matrix. This extended distally to sagittally stretched coils of vessels that straightened out as the nail matrix enters the nail bed region. At the edge of the proximal nail fold the capillary loops looked like fine bristles and were approximately 3 times shorter than those found on the nail bed and hyponychium. This study provides a baseline for future work in understanding the changes in the microvasculature of the dorsal fingertip due to injury or pathology.

PMID: 11279575
Knitted Poly-Lactide-Co-Glycolide Scaffold Loaded With Bone Marrow Stromal Cells In Repair And Regeneration Of Rabbit Achilles Tendon

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OBJECTIVE:
The objectives of this study were to evaluate the morphology and biomechanical function of Achilles tendons regenerated using knitted poly-lactide-co-glycolide (PLGA) loaded with bone marrow stromal cells (bMSCs).

METHODOLOGY:
The animal model used was that of an adult female New Zealand White rabbit with a 10-mm gap defect of the Achilles tendon. In group I, 19 hind legs with the created defects were treated with allogeneic bMSCs seeded on knitted PLGA scaffold. In group II, the Achilles tendon defects in 19 hind legs were repaired using the knitted PLGA scaffold alone, and in group III, 6 hind legs were used as normal control. The tendon-implant constructs of groups I and II were evaluated postoperatively at 2, 4, 8, and 12 weeks using macroscopic, histological, and immunohistochemical techniques. In addition, specimens from group I (n = 7), group II (n = 7), and group III (n = 6) were harvested for biomechanical test 12 weeks after surgery.

RESULTS:
Postoperatively, at 2 and 4 weeks, the histology of group I specimens exhibited a higher rate of tissue formation and remodeling as compared with group II, whereas at 8 and 12 weeks postoperation, the histology of both group I and group II was similar to that of native tendon tissue. The wound sites of group I healed well and there was no apparent lymphocyte infiltration. Immunohistochemical analysis showed that the regenerated tendons were composed of collagen types I and type III fibers. The tensile stiffness and modulus of group I were 87 and 62.6% of normal tendon, respectively, whereas those of group II were about 56.4 and 52.9% of normal tendon, respectively.

CONCLUSION:
These results suggest that the knitted PLGA biodegradable scaffold loaded with allogeneic bone marrow stromal cells has the potential to regenerate and repair gap defect of Achilles tendon and to effectively restore structure and function.

PMID: 12857411
In Vivo Study Of Anterior Cruciate Ligament Regeneration Using Mesenchymal Stem Cells And Silk Scaffold

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OBJECTIVE:

Although most in vitro studies indicate that silk is a suitable biomaterial for ligament tissue engineering, in vivo studies of implanted silk scaffolds for ligament reconstruction are still lacking. The objective of this study is to investigate anterior cruciate ligament (ACL) regeneration using mesenchymal stem cells (MSCs) and silk scaffold.

METHODOLOGY:

The scaffold was fabricated by incorporating microporous silk sponges into knitted silk mesh, which mimicked the structures of ligament extracellular matrix (ECM). In vitro culture demonstrated that MSCs on scaffolds proliferated vigorously and produced abundant collagen. The transcription levels of ligament-specific genes also increased with time. Then MSCs/scaffold was implanted to regenerate ACL in vivo.

RESULTS:

After 24 weeks, histology observation showed that MSCs were distributed throughout the regenerated ligament and exhibited fibroblast morphology. The key ligament ECM components including collagen I, collagen III, and tenascin-C were produced prominently. Furthermore, direct ligament-bone insertion with typical four zones (bone, mineralized fibrocartilage, fibrocartilage, ligament) was reconstructed, which resembled the native structure of ACL-bone insertion. The tensile strength of regenerated ligament also met the mechanical requirements. Moreover, its histological grading score was significantly higher than that of control.

CONCLUSION:

In conclusion, the results imply that silk scaffold has great potentials in future clinical applications.

PMID: 18462787
At present, the therapeutic options to treat tendon and ligament injuries include autografts, allografts, and prosthetic devices. However, there are many disadvantages in using biological grafts, as well as concerns over long term performance of synthetic prostheses. Therefore, further research for alternative repair methods is being pursued relentlessly; this includes development of tissue-engineered substitutes. It is well documented that when tendon injury leaves a large gap, it is usually difficult to bridge. If the tendon is completely missing then a graft or replacement device is usually necessary. Ligaments, on the other hand, have poor healing ability after any injury. There are numerous studies on the biology and biomechanics of healing tendon and ligament. However, information about the development process of tendon and ligament tissue is lacking. Currently, novel tissue-engineered techniques such as the application of growth factors and gene transfer have been explored. Furthermore, biodegradable biomaterials and cell therapy have been utilized with some success to improve the quality of tendons and ligaments during the healing process.

However, there are still a number of issues that need to be addressed: (1) the majority of tissue-engineered tendons and ligaments do not reach the required in vivo strength; (2) the abnormal interface between host bone and newly developed tissue poses a serious constraint in clinical applications; and (3) the rate of tissue regeneration is too slow. The present article provides a review of the state of art in tissue engineering of tendon and ligament, and attempts to address some the issues described above. We also highlight some of our more recent work.

PMID: 14511469
Epidemiology Of Diabetic Foot Problems And Predictive Factors For Limb Loss

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OBJECTIVE:

The aim of this study was to evaluate the epidemiology of diabetic foot problems (DFP) and predictive factors for major amputations (below- and above-knee).

METHODOLOGY:

This is a prospective study of 202 patients treated in National University Hospital (NUH) during the period of January 2005 to May 2006. A protocol was designed for documentation including patient profile, type of DFP, presence of risk factors, comorbidities and complications, clinical presentation, investigations, treatment given, and final outcome. The predictors for limb loss were determined using univariate and stepwise logistic regression analysis.

RESULTS:

One hundred ninety-two patients had Type 2 diabetes. Mean age of cohort was 60 years, with male to female ratio of 1:1. Incidence of DFP was significantly higher in Malays (P=.0015) and Indians (P=.036) and significantly lower in Chinese (P<.05). Of patients, 72.8% had poor endocrine control (GHb level >7%), and 42.1% of patients had sensory neuropathy based on 5.07 Semmes-Weinstein Monofilament test. Common DFP included gangrene (31.7%), infection (abscess, osteomyelitis) (28.7%), ulcer (27.7%), cellulitis (6.4%), necrotizing fasciitis (3.5%) and Charcot's osteoarthropathy (2.0%). Surgery was performed in 74.8% of patients and major amputation in 27.2% of patients (below-knee in 20.3% and above-knee in 6.9%).

CONCLUSION:

This is the first detailed prospective study evaluating predictive factors for major amputations in patients with DFP. Significant univariate predictive factors for limb loss were age above 60 years, stroke, ischaemic heart disease, nephropathy, peripheral vascular disease (PVD), sensory neuropathy, glycosylated haemoglobin level, Ankle Brachial Index (ABI) <0.8, gangrene, infection, and pathogens such as methicillin-resistant Streptococcus aureus (MRSA) and Staphylococcus aureus. Upon stepwise logistic regression analysis, only PVD and infection were significant.

PMID: 18280436
Assessment Of Sensory Neuropathy In Diabetic Patients Without Diabetic Foot Problems

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OBJECTIVE:

To study the incidence and extent of peripheral sensory neuropathy in diabetic patients without diabetic foot problems (DFPs) with <5, 5-10 and >10 years duration of diabetes using three different modalities of testing: Pin-Prick Testing, 5.07 Semmes-Weinstein Monofilament Testing (SWMT) and Rapid-Current Perception Threshold (R-CPT) measurements using the Neurometer.

METHODOLOGY:

Our study population consisted of 60 patients (120 feet) treated for diabetes mellitus in the Division of Endocrinology at the National University Hospital. No patient had any DFPs. Twenty-two, 21 and 17 patients had duration of diabetes of <5, 5-10 and >10 years, respectively. All patients were tested for sensory neuropathy using Pin-Prick Testing using a standardized protocol, SWMT and the Neurometer.

RESULTS:

There was a significantly higher incidence of sensory neuropathy detected by both the Pin-Prick Test and the Neurometer as compared to the SWMT. Also, in all three modalities, there was a significant increase in incidence of sensory neuropathy detected in diabetics with >5 years duration of diabetes. In addition, the Pin-Prick Test showed an increase in extent of sensory neuropathy with a longer duration of diabetes.

CONCLUSION:

The Pin-Prick Test was found to be a simple, cheap and useful diagnostic tool for detection of sensory neuropathy in diabetics without DFPs. In addition, it could accurately delineate the extent of neuropathy in the lower limb - additional useful information not obtainable with SWMT or Neurometer. Even for patients with <5 years duration of diabetes, the incidence of sensory neuropathy detected was considerable. The incidence of neuropathy detected continued to increase with length of duration of diabetes. Hence, we recommend screening of patients for neuropathy as soon as they are diagnosed with diabetes.

PMID: 18280443
Effectiveness Of Vacuum-Assisted Closure (VAC) Therapy In The Healing Of Chronic Diabetic Foot Ulcers

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OBJECTIVE:
This is the first prospective study done locally to determine the effectiveness of vacuum-assisted closure (VAC) therapy in the healing of chronic diabetic foot ulcers.

METHODOLOGY:
An electronic vacuum pump was used to apply controlled negative pressure evenly across the wound surface. Changes in wound dimension, presence of wound granulation and infection status of diabetic foot ulcers in 11 consecutive patients with diabetes were followed over the course of VAC therapy.

RESULTS:
Healing was achieved in all wounds. Nine wounds were closed by split-skin grafting and 2 by secondary closure. The average length of treatment with VAC therapy was 23.3 days. Ten wounds showed reduction in wound size. All wounds were satisfactorily granulated and cleared of bacterial infection at the end of VAC therapy.

CONCLUSION:
VAC therapy was useful in the treatment of diabetic foot infection and ulcers, which after debridement, may present with exposed tendon, fascia and/or bone. These included ray amputation wounds, wounds post-debridement for necrotising fasciitis, wounds post-drainage for abscess, a heel ulcer and a sole ulcer. It was able to prepare ulcers well for closure via split-skin grafting or secondary closure in good time. This reduced cost of VAC therapy, as therapy was not prolonged to attain greater reduction in wound area. VAC therapy also provides a sterile, more controlled resting environment to large, exudating wound surfaces. Large diabetic foot ulcers were thus made more manageable.

PMID: 20535423
Split Flexor Carpi Ulnaris Transfer: A New Functioning Free Muscle Transfer With Independent Dualfunction

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OBJECTIVE:
A functioning free muscle transfer is a well-established modality of restoring upper limb function in patients with significant functional deficits. Splitting the neuromuscular compartments of the free muscle based on its intramuscular neural anatomy and using each compartment for a different function would allow for restoration of two functions instead of one at the new distant site.

METHODOLOGY:
The authors previously reported on the clinical use of a pedicled split flexor carpi ulnaris muscle transfer. They now report the use of this muscle as a functioning free split muscle transfer to restore independent thumb and finger extension in a patient with total extensor compartment muscle loss in the forearm and a concomitant high radial nerve avulsion injury.

RESULTS:
Nine months postoperatively, the patient was able to extend his thumb and fingers independent of each other.

CONCLUSION:
This is the first report of a functioning free split muscle transfer demonstrating two independent functions in the upper limb.

PMID: 16651966

The Role Of Intramuscular Nerve Repair in The Recovery Of Lacerated Skeletal Muscles

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The repair of lacerated muscle often results in suboptimal recovery. An important cause of poor outcome is denervation of the distal segment. The rabbit medial gastrocnemius muscle laceration model was used to assess whether intramuscular nerve repair resulted in better recovery. Lacerated rabbit muscles were divided into three groups: group A had no muscle repair; group B underwent muscle repair; and group C had muscle repair within truncal muscle nerve repair. At 7 months, groups A and B showed significantly greater muscle atrophy, replacement of muscle fiber with scar and adipose tissue, and change of muscle fiber type from a fast-twitch to a slow-twitch pattern compared to group C. A clinical case study subsequently demonstrated feasibility of intramuscular nerve repair; reinnervation of the distal belly led to rapid functional recovery. In conclusion, primary intramuscular nerve repair results in better functional outcomes following repair of lacerated muscles.

PMID: 16320308


Intramuscular Innervation Of Upper-Limb Skeletal Muscles

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We studied 150 skeletal muscles from 8 upper limbs using the modified Sihler’s staining technique. Based on the pattern of the intramuscular innervation and shape, the muscles were grouped into trapezoidal-shaped (Class I), spindle-shaped (Class II), and muscles that were combinations of these two classes (Class III). Such distinctions are clinically important for limb reconstruction procedures. Bipennate, spindle-shaped muscles with the aponeurosis of the tendons of insertion extending proximally into the muscle belly and Class III muscles with multiple tendons of origin may be split for separate independent functional transfers.

PMID: 15052617
Autologous Bone Marrow–Derived Mesenchymal Stem Cells Versus Autologous Chondrocyte Implantation: An Observational Cohort Study
Hossein Nejadnik, James H. Hui, Erica Pei Feng Choong, Bee-Choo Tai and Eng Hin Lee

OBJECTIVE:
First-generation autologous chondrocyte implantation has limitations, and introducing new effective cell sources can improve cartilage repair. This study was conducted to compare the clinical outcomes of patients treated with first-generation autologous chondrocyte implantation to patients treated with autologous bone marrow–derived mesenchymal stem cells (BMSCs).

METHODOLOGY:
Seventy-two matched (lesion site and age) patients underwent cartilage repair using chondrocytes (n = 36) or BMSCs (n = 36). Clinical outcomes were measured before operation and 3, 6, 9, 12, 18, and 24 months after operation using the International Cartilage Repair Society (ICRS) Cartilage Injury Evaluation Package, which included questions from the Short-Form Health Survey, International Knee Documentation Committee (IKDC) subjective knee evaluation form, Lysholm knee scale, and Tegner activity level scale. STUDY DESIGN: Cohort study; Level of evidence, 3.

RESULTS:
There was significant improvement in the patients’ quality of life (physical and mental components of the Short Form-36 questionnaire included in the ICRS package) after cartilage repair in both groups (autologous chondrocyte implantation and BMSCs). However, there was no difference between the BMSC and the autologous chondrocyte implantation group in terms of clinical outcomes except for Physical Role Functioning, with a greater improvement over time in the BMSC group (P = .044 for interaction effect). The IKDC subjective knee evaluation (P = .861), Lysholm (P = .627), and Tegner (P = .200) scores did not show any significant difference between groups over time. However, in general, men showed significantly better improvements than women. Patients younger than 45 years of age scored significantly better than patients older than 45 years in the autologous chondrocyte implantation group, but age did not make a difference in outcomes in the BMSC group.

CONCLUSION:
Using BMSCs in cartilage repair is as effective as chondrocytes for articular cartilage repair. In addition, it required 1 less knee surgery, reduced costs, and minimized donor-site morbidity.

SIGNIFICANCE OF THIS PUBLICATION:
This piece of work was the first in the world’s literature comparing culture bone marrow stem cells versus autologous chondrocytes in clinical use.

PMID: 20392971
Enhancement Of Tendon Graft Osteointegration Using Mesenchymal Stem Cells In A Rabbit Model Of Anterior Cruciate Ligament Reconstruction

Jit-Kheng Lim, James Hui, Li Li, Ashvin Thambyah, James Goh, Eng-Hin Lee

OBJECTIVE
To study the effect of coating tendon grafts with mesenchymal stem cells (MSCs) on the rate and quality of graft osteointegration in anterior cruciate ligament (ACL) reconstruction.

METHODOLOGY:
Bilateral ACL reconstructions using hamstring tendon autografts were performed on 48 adult rabbits. Grafts were coated with MSCs in a fibrin glue carrier in one limb, and fibrin glue only in the other. Assessment was done at 2, 4, and 8 weeks. Histologic analysis was carried out using standard and immunohistochemical stains. Biomechanical testing of force and stiffness during loading to ultimate failure was performed.

RESULTS AND CONCLUSION:
Control reconstructions showed mature scar tissue with some Sharpey's-like fibers spanning the tendon-bone interface at 8 weeks. The MSC-enhanced reconstructions had large areas of cartilage cells at the tendon-bone junction at 2 weeks. By 8 weeks, a mature zone of cartilage was seen gradually blending from bone into the tendon grafts. This zone stained strongly for type II collagen and showed histologic characteristics similar to normal rabbit ACL insertions. Biomechanically, there was no statistical difference between limbs at 2 and 4 weeks. At 8 weeks, the MSC-enhanced grafts had significantly higher failure load and stiffness. Conclusions: Coating of tendon grafts with MSCs results in healing by an intervening zone of cartilage resembling the chondral enthesis of normal ACL insertions rather than collagen fibers and scar tissue. MSC-enhanced ACL reconstructions perform significantly better than controls on biomechanical testing. Clinical relevance: Enhancement of tendon graft osteointegration with MSCs is a novel method offering the potential for more physiologic and biomechanically stronger ligament reconstructions.

SIGNIFICANCE OF THIS PUBLICATION:
This is the first in the literature highlighting the use of stem cells in osteointegration in hamstring graft in ACL reconstruction.

PMID: 15525922
Injectable Mesenchymal Stem Cell Therapy for Large Cartilage Defects—A Porcine Model

Kevin B.L. Lee, James H.P. Hui, Im Chim Song, Lenny Ardany, Eng Hin Lee

OBJECTIVE:
Current techniques in biological resurfacing of cartilage defects require an open arthrotomy or arthroscopy and involve the direct transplantation of isolated cells and/or scaffolds or whole tissue grafts with chondrogenic potential onto the cartilage defect. Our study investigates the possibility of direct intra-articular injection of mesenchymal stem cells suspended in hyaluronic acid (HA) as an alternative to the much more invasive methods currently available.

METHODOLOGY:
A partial-thickness (without penetration of the subchondral bone) cartilage defect was created in the medial femoral condyle of an adult minipig. Mesenchymal stem cells from the iliac crest marrow of the same pig harvested in a separate procedure and suspended in 2 milliliters of hylan G-F 20 (Synvisc) were injected intra-articularly after the creation of the defect. This was followed by two more injections of hylan G-F 20 (HA) at weekly intervals. Either saline or HA was injected into the knees of the controls. The pigs were sacrificed at 6 and 12 weeks for morphological and histological analysis.

RESULTS AND CONCLUSION:
The cell-treated groups showed improved cartilage healing both histologically and morphologically at 6 and 12 weeks compared with both controls. The use of intra-articular injections of mesenchymal stem cells suspended in HA is a viable option for treating large cartilage defects. This would be further explored in clinical trials.

SIGNIFICANCE OF THE PUBLICATION:
This is the first in the in vivo study in the large animal model detailing the mechanism of injectable stem cells in the healing of cartilage defects.

PMID: 17656639
Bilateral Gluteal Compartment Syndrome: A Case Report.

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The early detection of compartment syndrome is essential in order to reduce disability and the consequences of ensuing ischemia. We report a case of posttraumatic bilateral gluteal compartment syndrome that initially was thought to be a simple buttock contusion. Gluteal compartment syndrome has been associated with sciatic nerve palsy, massive rhabdomyolysis, renal failure, multiple-organ failure, and death1-3. It is essential for the trauma surgeon to understand the anatomy of the nondistensible osseofascial compartments of the gluteal region and to be aware of the techniques of compartment pressure measurement at this uncommon site so that adequate decompression can be carried out early, before irreversible tissue damage occurs. Our patient had an adverse outcome resulting from the failure to recognize and diagnose the condition in time. The patient was informed that the data concerning the case would be submitted for publication.

Necrotising Fasciitis Caused By Adulterated Traditional Asian Medicine: A Case Report

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Necrotising fasciitis can be life threatening, requiring prompt diagnosis and surgical debridement. We report a case of necrotising fasciitis caused by an adulterate traditional Asian medication—Jamu Pegal Linu, containing toxic levels of phenylbutazone and dipyrone. The patient presented with severe neutropenia and sepsis. An urgent extensive debridement was carried out (within 6 hours of presentation). Repeated debridements were performed on days 2 and 5, augmented with antibiotics and granulocyte colony-stimulating factor.
A Case Report Of Neurologically Unstable Fracture Of The Lumbosacral Spine In A Patient With Ankylosing Spondylitis

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INTRODUCTION:
Fracture/dislocation is uncommonly reported in ankylosing spondylitis involving the lumbosacral spine.

CLINICAL PICTURE:
We report an 18-month follow-up of a case of neurologically unstable traumatic fracture of the lumbosacral spine in ankylosingspondylitis. TREATMENT/OUTCOME: Posterior decompression, alar-transverse fusion and instrumentation were performed. Anterior diskectomy and fusion were done 6 weeks later. There was solid bony fusion on follow-up and the patient had improvement of 2 Frankel grades and was able to ambulate.

CONCLUSION:
Combined approaches and longer fixations to stabilise the spine may be required. In the lumbosacral spine, this poses a problem vis-à-vis limited levels of fixation in the sacrum.

PMID: 11885486
OBJECTIVES:
Lumbar fusion surgery is thought to relieve discogenic low back pain by eliminating the abnormal intersegmental movement at the level of disc degeneration. Successful spinal fusion does not guarantee symptomatic pain relief. Discogenic pain is also known to be associated with an abnormal load transmission pattern across the degenerate disc. We hypothesized that the lumbar interbody fusion results in relief of discogenic pain by normalizing the load distribution pattern. We aim to study and compare the stress distribution patterns in a normal spinal segment and in the adjacent vertebrae of a fused spinal segment. The effect of bone graft incorporation around the mesh cage was also investigated.

METHODOLOGY:
A 2-dimensional axisymmetric finite element model of an intervertebral segment was used to investigate the stress patterns in the adjacent vertebrae of fused spinal segment incorporating 4 common cage designs. The same was used to study the effect of maturation of bone graft on stress distribution pattern. We used a 2-dimensional axisymmetric finite element model of an intervertebral segment to investigate the stress patterns in the vertebrae adjacent to a fused spinal segment incorporating 4 common cage designs: (1) anterior lumbar interbody fusion, (2) posterior lumbar interbody fusion rectangular, (3) posterior lumbar interbody fusion threaded, and (4) mesh cage.

RESULTS:
High stress concentrations and abnormal overall stress patterns were noted for all the cage designs studied. The anterior lumbar interbody fusion cage with its larger contact area showed the least abnormal stress magnitude in comparison with the other cages. Incorporation of bone in and around the mesh cage increased the area of contact and decreased the abnormal high stresses. The spine fusion model representing final bony healing showed restoration of near physiologic stress pattern.

CONCLUSION:
Interbody fusion cages with larger area of contact between cage and vertebral endplate produces a lower stress distribution pattern. A successful bony fusion restores near physiologic stress distribution pattern. Restoration of near normal load distribution pattern may become an important aim of surgery for discogenic low back pain.

PMID: 16094274
Cervical Foraminal Selective Nerve Root Block: A ‘Two-Needle Technique’ With Results

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OBJECTIVE:

Several techniques have been described for selective nerve root blocks. We describe a novel ‘two-needle technique’, performed through the postero-lateral route with the patient in lateral position under C-arm guidance. The aim of the current study is to highlight the effectiveness and safety of cervical selective nerve root block for radiculopathy using this technique.

METHODOLOGY:

We present results of a retrospective 2-year follow-up study of 33 injections carried out on 33 patients with radiculopathy due to cervical disc disease and or foraminal stenosis using this procedure. Patients with myelopathy, gross motor weakness and any other pathology were excluded. The outcome was measured comparing ‘Visual Analogue Score’ (VAS) and ‘Neck Disability Index’ (NDI) before the procedure with those at 6 weeks and 12 months after the procedure.

RESULTS:

Thirty patients were included in the final analysis. Average pre-operative VAS score was 7.4 (range 5-10), which improved to 2.2 (range 0-7) at 6 weeks and 2.0 (range 0-4) at 1 year and the mean NDI score prior to intervention was 66.9 (range 44-84), which improved to 31.7 (range 18-66) at 6 weeks and 31.1 (range 16-48) at 1 year. The improvements were statistically significant. Patients with involvement of C6 or C7 nerve roots responded slightly better at 6 weeks with regards to VAS improvement. Mean duration of radiation exposure during the procedure was 27.8 s (range 10-90 s). Only minor complications were noted—transient dizziness in two and transient nystagmus in one patient.

CONCLUSION:

Our ‘two-needle technique’ is a new, safe and effective non-surgical treatment for cervical radiculopathy.

PMID: 18204941
Functional Anatomy Of The Deer Spine: An Appropriate Biomechanical Model For The Human Spine?

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OBJECTIVE:
The object of this study was to create a database for the biomechanical and certain functional anatomical parameters of the deer spine, for comparison with the human spine. This was done with a view toward using the deer spine as an alternative model for various biomechanical experiments, as it is difficult to procure nonembalmed, fresh human spine specimens. Bovine spongiform encephalopathy (BSE) and its human variant, Creutzfeld Jakob disease (CJD), prevent us from using bovine and sheep spine. There is a risk of transmission of disease through direct inoculation to the researcher working with infected bovine or sheep spine, and a theoretical possibility of transmission through the food chain if proper precautions for specimen disposal are not taken.

METHODOLOGY:
We chose deer spine as an alternative for testing non-embalmed fresh human spine because, to date, there have been no reported cases of deer being carriers of prion diseases. Fifteen deer spine specimens were sectioned appropriately to obtain six functional spinal units for each level in the thoracic and lumbar spine. Each unit was tested in a Dartec materials testing machine (Dartec Ltd., Stourbridge, UK) under pure moments in three main anatomical planes. The range of motion (ROM), neutral zone (NZ), and stiffness parameters of the functional unit were determined in flexion-extension, right/left lateral bending, and axial rotation. The data obtained were compared with the corresponding human spine data in the literature. Deer spine specimens were also studied for bone mineral density (BMD) using a DEXA scan.

RESULTS:
The results revealed the overall ROM was greater for deer spine compared to the human spine in the upper thoracic region, but less compared to human spine in the lower lumbar spine region. The only comparable region for ROM was in the lower thoracic/upper lumbar region. The stiffness coefficients were also comparable in this region. The BMD was also comparable in the two species.

CONCLUSION:
We conclude that the lower thoracic/upper lumbar region in the deer spine can be used as a model for some human biomechanical experiments because of its biomechanical and material similarities to the human spine of the corresponding region.
Reconstruction Of Extremity Long Bone Defects After Sarcoma Resection With Vascularized Fibulaflaps: A 10-Year Review


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OBJECTIVE:
Limb-sparing wide excision has become as effective as amputation in treating extremity sarcoma. Limb reconstruction has traditionally involved allografting. The authors evaluated reconstruction of extremity long bone defects after tumor resection using fibula free flaps.

METHODOLOGY:
A retrospective chart review (1991 to 2002) was performed of 25 consecutive patients at Memorial Sloan-Kettering Cancer Center who underwent reconstruction with free fibula flaps after limb-sparing resection of extremity sarcomas. Timing of reconstruction, complications, metastasis, survival, bone union, and functional outcome were analyzed. Functional assessment was based on the 1987 Musculoskeletal Tumor Society Score/Enneking classification.

RESULTS:
Twenty-five patients (14 male patients and 11 female patients) were treated. Osteosarcoma (n = 8), Ewing’s sarcoma (n = 8), and chondrosarcoma (n = 6) accounted for the majority of the cases. Reconstructed areas included tibia (n = 9), radius (n = 5), humerus (n = 6), femur (n = 4), and ulna (n = 1). All flaps survived (100 percent). One patient required emergent reexploration (4 percent), one suffered partial flap skin loss (4 percent), and three experienced postoperative infections (12 percent). In patients followed over 6 months, uncomplicated bony union was achieved in 11 of 14 patients (78 percent). After secondary procedures, bony union was ultimately achieved in 13 of 14 patients (93 percent), all of whom had good functional outcomes. Eight patients suffered local recurrences or metastases (32 percent); six died during the study period.

CONCLUSION:
The microvascular free fibula flap has a lower infection rate than traditional allograft reconstruction. There is a high rate of bone union, and functional outcome is good. Thus, the authors recommend the microvascular fibula transfer as the technique of choice for reconstructing large, complex long bone defects resulting from tumor extirpation.

PMID: 17312496
Cell-Based Therapy In The Repair Of Osteochondral Defects: A Novel Use For Adipose Tissue.

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Mesenchymal stem cells are currently procured from periosteum and bone marrow. The procurement of stem cells from these sources is tedious and gives a low yield of cells. This study was aimed at circumventing these problems and allowing for a method that would be more acceptable in the clinical setting. Tissue for transplantation was harvested from a single New Zealand White rabbit. Cells were more readily obtained from adipose tissue than from bone marrow or periosteum. The present method also provided a better yield of cells through culture. In vitro studies were performed to assess the differentiation potential of these cells. Successful in vitro transformation into alternative mesenchymal cell lines including cardiomyocytes revealed these cells to have wide differentiation potential. Further characterization morphologically, immunohistochemically, and via gene transfection showed features consistent with mesenchymal stem cells. Cultured cells were then transplanted into defects created in the left medial femoral condyle. The femora were harvested at various intervals and the repair tissue was assessed. Gross osteochondral defect reconstitution and histological grading was superior to periosteum-derived stem cell repair and repair by native mechanisms. Biomechanically, the repair tissue approximated intact cartilage and was superior to osteochondral autografts and repair by innate mechanisms.

PMID: 13678450

Dickkopf 3 Inhibits Invasion And Motility Of Saos-2 Osteosarcoma Cells By Modulating The Wnt-Beta-Catenin Pathway

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Osteosarcoma (OS) is a primary malignancy of bone with a tendency to metastasize early. Despite intensive chemotherapy and surgical resection, approximately 30% of patients still develop distant metastasis. Our previous work using clinical OS samples suggested that expression of the Wnt receptor LRP5 might be associated with tumor metastasis. In the present study, we used a Dickkopf (Dkk) family member and a dominant-negative LRP5 receptor construct to modulate Wnt signaling in OS cells. Saos-2 cells, which ectopically express Dkk-3, do not undergo apoptosis and exhibit enhanced resistance to serum starvation and chemotherapy-induced cytotoxicity. Transfection of Dkk-3 and dominant-negative LRP5 into Saos-2 cells significantly reduces invasion capacity and cell motility. This blockade is associated with changes in cell morphology consistent with a less invasive phenotype. In addition, Dkk-3 and dominant-negative LRP5 also induce changes in beta-catenin localization consistent with an increase in cell-cell adhesion. Taken together, these results support a possible role for Wnt signaling in the pathobiology and progression of human OS.

PMID: 15087387
OBJECTIVE:
Although total joint replacement has become commonplace in recent years, bacterial infection remains a significant complication following this procedure. One approach to reduce the incidence of joint replacement infection is to add antimicrobial agents to the bone cement used to fix the implant. In this in vitro study, we investigated the use of chitosan nanoparticles (CS NP) and quaternary ammonium chitosan derivative nanoparticles (QCS NP) as bactericidal agents in poly(methyl methacrylate) (PMMA) bone cement with and without gentamicin.

METHODOLOGY:
The antibacterial activity was tested against Staphylococcus aureus (S. aureus) and Staphylococcus epidermidis (S. epidermidis). A 10(3)-fold reduction in the number of viable bacterial cells upon contact with the surface was achievable using QCS NP at a nanoparticle/bone cement weight ratio of 15%.

RESULTS:
The inhibition of S. aureus and S. epidermidis growth on the surface of the CS NP and QCS NP-loaded bone cements was clearly shown using the LIVE/DEAD BacLight bacterial viability kits and fluorescence microscopy. The CS NP and QCS NP also provided a significant additional bactericidal effect to gentamicin-loaded bone cement. The antibacterial effectiveness remained high even after the modified bone cements had been immersed for 3 weeks in an aqueous medium. No cytotoxic effect of the CS NP- and QCS NP-loaded cements was shown in a mouse fibroblast MTT cytotoxicity assay. Mechanical tests indicated that the addition of the CS and QCS in nanoparticulate form allowed the retention of a significant degree of the bone cement’s strength.

CONCLUSION:
These results indicate a new promising strategy for combating joint implant infection.
OBJECTIVE:

Titanium (Ti) and its alloys are used extensively in orthopedic implants due to their excellent biocompatibility and mechanical properties. However, titanium-based implant materials have specific complications associated with their applications, such as the loosening of implant-host interface owing to unsatisfactory cell adhesion and the susceptibility of the implants to bacterial infections. Hence, a surface which displays selective biointeractivity, i.e. enhancing beneficial host cell responses but inhibiting pathogenic microbial adhesion, would be highly desirable.

METHODOLOGY:

This present study aims to improve biocompatibility and confer long-lasting antibacterial properties on Ti via polyelectrolyte multilayers (PEMs) of hyaluronic acid (HA) and chitosan (CH), coupled with surface-immobilized cell-adhesive arginine-glycine-aspartic acid (RGD) peptide.

RESULTS:

The HA/CH PEM-functionalized Ti is highly effective as an antibacterial surface but the adhesion of bone cells (osteoblasts) is poorer than on pristine Ti. With additional immobilized RGD moieties, the osteoblast adhesion can be significantly improved.

CONCLUSION:

The density of the surface-immobilized RGD peptide has a significant effect on osteoblast proliferation and alkaline phosphatase (ALP) activity, and both functions can be increased by 100-200% over that of pristine Ti substrates while retaining high antibacterial efficacy. Such substrates can be expected to have good potential in orthopedic applications.

PMID: 18190959
The Effect Of VEGF Functionalization Of Titanium On Endothelial Cells In Vitro

Poh, Chye Khoon; Shi, Zhilong; Lim, Tee Yong; Neoh, Koon Gee; Wang, Wilson

OBJECTIVE:

One of the key challenges in bone healing and regeneration is the engineering of an implant with surface properties that can enhance revascularization to meet the metabolic demands of recovery. Successful implant integration into the surrounding tissue is highly dependent on the crucial role of blood supply in driving bone repair and development. Therapeutic application of vascular endothelial growth factor (VEGF) is a promising approach to enhance blood supply and healing through revascularization around an engineered implant in a regulated manner. In this in vitro study, we investigated the effects of immobilized VEGF on titanium alloy substrates coated with thin adherent polydopamine film.

METHODOLOGY:

X-ray photoelectron spectroscopy (XPS) was used to determine the chemical composition of the surfaces at various stages of surface functionalization to verify the successful deposition of polydopamine and VEGF on the metal surface. Surface topography was evaluated from the surface profile determined by atomic force microscopy (AFM).

RESULTS:

The functionalized surfaces showed a significant increase in human dermal microvascular endothelial cells (HDMECs) attachment, viability and proliferation compared to the pristine substrate. Furthermore the immobilized VEGF was able to induce the differentiation of human mesenchymal stem cells (hMSCs) into endothelial cells.

CONCLUSION:

Utilizing the reactivity of polydopamine films to immobilize VEGF onto metal substrates may provide a promising approach for application in situations where revascularization around implants would be beneficial in improving bone healing and implant integration.

PMID: 19963265

Continuous Local Anaesthesia For Post-operative Mobilization Of Injured Digits

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We have studied the effects of sustained local anaesthesia on postoperative mobilization of the injured hand. Small epidural catheters were placed adjacent to the peripheral nerves providing sensation to the involved part of the hand under direct vision in the distal forearm. Repeated doses of 0.5% bupivacaine were then administered during mobilization therapy to relieve pain. Fourteen out of 24 digits (60%) recorded 30 degrees or more increases in active range of motion after bupivacaine injection. The cases that failed to improve had suffered severe injuries. Complications were few and were easily managed as the catheters were distal, superficial and accessible. This is an effective, specific and safe method of providing sustained postoperative analgesia for mobilization.

PMID: 14599821


Heterodigital Vascular Island Flap For Simultaneous Resurfacing And Revascularization Of Digits

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Devascularized digits with segmental skin and vessel loss require revascularization and resurfacing. This can be addressed by using a heterodigital vascular island flap. This flap brings with it an appropriately sized pristine artery of optimal length for revascularization and provides simultaneous skin cover. We describe 3 cases. Primary wound healing was achieved in all patients with good functional recovery and acceptable donor site morbidity. We compare the options available for reconstructing such defects and discuss other possible surgical indications for this flap.

PMID: 19131716
Reverse Anterior Tibial Artery Flap For Reconstruction Of Foot Donor Site

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The foot offers numerous useful options for hand reconstruction. Hallux transfer, dorsalis pedis flap, second toe transfers, and toe joint transfers offer good functional results in reconstructed hands. However, when the donor site is repaired with skin grafts, delayed wound healing, scarring, and contractures often result. Poor cosmesis of the donor site and altered gait are the main drawbacks of the procedures. The authors propose a new concept of primary reconstruction of the donor foot using a reverse-flow anterior tibial flap from the same leg. Two flaps are raised from the same anterior tibial vessel system in continuity as a distal free flap for hand reconstruction and as a proximal reverse-flow pedicled flap to resurface the donor defect. This technique allows good flap reconstruction of the foot donor site, reducing morbidity and limiting the operation to the same limb. The authors report their experience of 33 cases. There were no failures. Primary wound healing was achieved in the foot donor site, with acceptable cosmesis and satisfactory function.

PMID: 14578791


Tissue Engineering For The Hand Surgeon: A Clinical Perspective

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Hand surgeons may be faced with tissue shortages for reconstruction after trauma, tumor resection, or congenital deficiency. Tissue engineering is a developing scientific field that combines the principles of life sciences and engineering in developing biologic substitutes that will restore, maintain, or improve tissue function. This article reviews the general principles of tissue engineering as applied to musculoskeletal tissues including nerve, bone, tendon, skin, vessels, and cartilage and focuses on the application of tissue engineering that is relevant to clinical hand surgery.

PMID: 16516727
Bone Marrow-derived Mesenchymal Stem Cells Influence Early Tendon-healing In A Rabbit Achilles Tendon Model

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OBJECTIVE:
A repaired tendon needs to be protected for weeks until it has accrued enough strength to handle physiological loads. Tissue-engineering techniques have shown promise in the treatment of tendon and ligament defects. The present study tested the hypothesis that bone marrow-derived mesenchymal stem cells can accelerate tendon-healing after primary repair of a tendon injury in a rabbit model.

METHODOLOGY:
Fifty-seven New Zealand White rabbits were used as the experimental animals, and seven others were used as the source of bone marrow-derived mesenchymal stem cells. The injury model was a sharp complete transection through the midsubstance of the Achilles tendon. The transected tendon was immediately repaired with use of a modified Kessler suture and a running epitendinous suture. Both limbs were used, and each side was randomized to receive either bone marrow-derived mesenchymal stem cells in a fibrin carrier or fibrin carrier alone (control). Postoperatively, the rabbits were not immobilized. Specimens were harvested at one, three, six, and twelve weeks for analysis, which included evaluation of gross morphology (sixty-two specimens), cell tracing (twelve specimens), histological assessment (forty specimens), immunohistochemistry studies (thirty specimens), morphometric analysis (forty specimens), and mechanical testing (sixty-two specimens).

RESULTS:
There were no differences between the two groups with regard to the gross morphology of the tendons. The fibrin had degraded by three weeks. Cell tracing showed that labeled bone marrow-derived mesenchymal stem cells remained viable and present in the intratendinous region for at least six weeks, becoming more diffuse at later time-periods. At three weeks, collagen fibers appeared more organized and there were better morphometric nuclear parameters in the treatment group (p < 0.05). At six and twelve weeks, there were no differences between the groups with regard to morphometric nuclear parameters. Biomechanical testing showed improved modulus in the treatment group as compared with the control group at three weeks (p < 0.05) but not at subsequent time-periods.

CONCLUSION:
Intratendinous cell therapy with bone marrow-derived mesenchymal stem cells following primary tendon repair can improve histological and biomechanical parameters in the early stages of tendon-healing.

PMID: 17200313

Flexor Tendon Tissue Engineering: Acellularized And Reseeded Tendon Constructs
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OBJECTIVE:
Tissue engineering of flexor tendons requires scaffolds with adequate strength and biocompatibility. The biomechanical properties of acellularized and reseeded flexor tendon scaffolds are unknown. Acellularized tendons and reseeded constructs were tested to determine whether the treatment process had altered their biomechanical properties.

METHODOLOGY:
Rabbit flexor tendons were acellularized using a freeze-thaw cycle followed by trypsin and Triton-X treatment. Complete acellularization of the tendon samples was confirmed by histology and by attempting to obtain viable cells by trypsin treatment of acellularized tendon. Reseeded constructs were obtained by incubating acellularized tendons in a tenocyte suspension. Tensile testing was performed to compare the ultimate tensile stress and elastic modulus of acellularized tendons and reseeded flexor tendon constructs to control flexor tendons.

RESULTS:
The treatment protocol successfully acellularized flexor tendons. No cells were seen within the tendon on histologic assessment, and no viable cells could be obtained from acellularized tendon. Acellularized tendon was successfully reseeded with tenocytes, although cell adhesion was limited to the surface of the tendon scaffold. Tensile testing showed that acellularized tendon had the same ultimate stress and elastic modulus as normal tendons. Reseeded tendons had the same elastic modulus as normal tendons, but hind-paw tendon constructs showed a decrease in ultimate stress compared with normal tendons (50.09 MPa versus 66.01 MPa, p = 0.026).

CONCLUSION:
Acellularized flexor tendons are a potential high-strength scaffold for flexor tendon tissue engineering. This approach of acellularization and reseeding of flexor tendons may provide additional intrasynovial graft material for hand reconstruction.

PMID: 19483576
The Management Of Severe Acetabular Bone Defects In Revision Hip Arthroplasty Using Modularporous Metal Components

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OBJECTIVE:
We investigated the early results of modular porous metal components used in 23 acetabular reconstructions associated with major bone loss.

METHODOLOGY:
The series included seven men and 15 women with a mean age of 67 years (38 to 81), who had undergone a mean of two previous revisions (1 to 7). Based on Paprosky's classification, there were 17 type 3A and six type 3B defects. Pelvic discontinuity was noted in one case. Augments were used in 21 hips to support the shell and an acetabular component-cage construct was implanted in one case. At a mean follow-up of 41 months (24 to 62), 22 components remained well fixed. Two patients required rerevision of the liners for prosthetic joint instability.

RESULTS:
Clinically, the mean Harris Hip Score improved from 43.0 pre-operatively (14 to 86) to 75.7 post-operatively (53 to 100). The mean pre-operative Merle d'Aubigné score was 8.2 (3 to 15) and improved to a mean of 13.7 (11 to 18) post-operatively.

CONCLUSION:
These short-term results suggest that modular porous metal components are a viable option in the reconstruction of Paprosky type 3 acetabular defects. More data are needed to determine whether the system yields greater long-term success than more traditional methods, such as reconstruction cages and structural allografts.

PMID: 19949116
The Femoral Sulcus In Total Knee Arthroplasty

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OBJECTIVE:
The position of the femoral sulcus relative to the midline of the distal femoral resection in total knee arthroplasty (TKA) was studied to determine if centralized placement of the femoral component on the distal femur was justified in terms of aligning the prosthetic sulcus with the native femoral sulcus.

METHODOLOGY:
The location of the femoral sulcus was studied in 112 consecutive patients undergoing TKA.

RESULTS:
The mean sulcus position was 0.7 mm lateral to the midline of the distal femoral resection (SD 1.4, 95% CI, 0.5-1.0 mm). However, the variation in sulcus positions ranged from 4 mm medial to 4 mm lateral to the midline. The mean sulcus position in valgus knees was 1.0 mm lateral to the midline (SD 1.8), and that in varus knees was 0.7 mm lateral to the midline (SD 1.2) (P = 0.501).

CONCLUSION:
It appears prudent to centre the femoral component on the native sulcus rather than the midline of the distal femoral resection, so as to ensure accurate alignment of the prosthetic sulcus with the native sulcus and to encourage normal patella tracking.

PMID: 19184591
Vascular Endothelial Growth Factor (VEGF) Is Expressed During Articular Cartilage Growth And Re-Expressed In Osteoarthritis

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OBJECTIVE:
Vascular endothelial growth factor (VEGF) is expressed in osteoarthritic articular cartilage. However, the pattern of VEGF expression throughout the whole life cycle of articular cartilage is not well elucidated. The aim of the study was to investigate the spatio temporal expression of VEGF and its receptors, vascular endothelial growth factor receptor-1 (VEGFR1) and vascular endothelial growth factor receptor-2 (VEGFR2), in articular cartilage during growth, maturation and degeneration, using the guinea pig model of spontaneous osteoarthritis.

METHODOLOGY:
Sections of tibial plateaus aged 2, 6 and 12 months were obtained, representing growing, mature and osteoarthritic cartilage respectively. Expression of VEGF and its receptors was determined by immunohistochemistry and in situ hybridisation.

RESULTS:
At 2 months, VEGF and its receptors were expressed in chondrocytes within the superficial layer of the articular cartilage. At 6 months, no expression of VEGF and its receptors was noted. In the 12-month-old specimens, VEGF and its receptors were expressed in chondrocytes within articular cartilage that exhibited osteoarthritic changes (medial tibial plateaus), but not in the histologically normal lateral plateaus.

CONCLUSION:
This spatiotemporal distribution of VEGF and its receptors suggests that VEGF is expressed during articular cartilage growth, becomes quiescent at maturity, and is re-expressed in osteoarthritis.

PMID: 20535432
OBJECTIVE:
The aim of this study was to define a posterior neuromuscular compartment of the deltoid with adequate innervation and circulation for use as a local transposition flap as well as a functional flap to restore shoulder and elbow function.

METHODOLOGY:
The nerve supply and blood supply to the posterior one third of the deltoid was studied in 20 cadaveric shoulders.

RESULTS:
A posterior neuromuscular compartment of the deltoid with adequate circulation and innervation was identified. It was feasible to transpose it for local coverage about the shoulder and to restore shoulder abduction and elbow extension.

CONCLUSION:
A posterior neuromuscular functional compartment of the deltoid has been identified.

PMID: 15861071
High Definition Ultrasound As Diagnostic Adjunct For Incomplete Carpal Tunnel Release

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Carpal tunnel syndrome is the most common nerve entrapment in the upper limb and carpal tunnel release (CTR) provides the most predictable outcome and relief of symptoms. Incomplete carpal tunnel releases are uncommon, however, in the event of incomplete surgical releases, symptoms following such incomplete releases tend to be more severe than the symptoms presented at the initial complaint. We present our experience in utilizing high definition ultrasound to reliably and accurately localize the anatomical cause to aid focused revision CTR.

PMID: 22072462

Localised Hypertrophic Mononeuropathy (LHM) As A Complication Of Peripheral Nerve Decompression Surgery

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Localised hypertrophic mononeuropathy is the progressive enlargement of a large peripheral nerve, which can lead to profound loss of function. In this case report, we describe the postoperative occurrence of this phenomenon and possible ways to monitor for this condition.

PMID: 20728985
Electrospun Poly(L-Lactide-Co-Glycolide) Biodegradable Polymer Nanofibre Tubes For Peripheral Nerve Regeneration

T B Bini, Shujun Gao, Ter Chyan Tan, Shu Wang, Aymeric Lim, Lim Ben Hai and S Ramakrishna

OBJECTIVE:
Nanotechnology is an area receiving increasing attention as progress is made towards tailoring the morphology of polymeric biomaterial for a variety of applications. In the present study an attempt was made to electrospin poly(L-lactide-co-glycolide) biodegradable polymer nanofibres.

METHODOLOGY:
In this process, polymer fibres with diameters down to the nanometre range are formed by subjecting a fluid jet to a high electric field. The nanofibres were collected on to a rotating Teflon mandrel and fabricated to tubes or conduits, to function as nerve guidance channels. The feasibility of in vivo nerve regeneration was investigated through several of these conduits. The biological performance of the conduits were examined in the rat sciatic nerve model with a 10 mm gap length. After implantation of the nanofibre nerve guidance conduit to the right sciatic nerve of the rat, there was no inflammatory response.

RESULTS:
One month after implantation five out of eleven rats showed successful nerve regeneration. None of the implanted tubes showed tube breakage. The nanofibre nerve guidance conduits were flexible, permeable and showed no swelling.

CONCLUSION:
Thus, these new poly(L-lactide-co-glycolide) nanofibre conduits can be effective aids for nerve regeneration and repair. Improvements could be done by impregnating nerve growth factors or Schwann cells and may lead to clinical applications.
Myosin Heavy Chain Isoform Profiles Remain Altered At 7 Months If The Lacerated Medial Gastrocnemius Is Poorly Reinnervated: A Study In Rabbits

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OBJECTIVE:
Lacerated skeletal muscles often do not recover full function after repair. Denervated muscles with altered myosin heavy chain isoform (MHC) profiles are known to result in functional impairment.

METHODOLOGY:
We studied the functional recovery of lacerated muscles, assessing MHC profile changes in association to the involvement of the intramuscular nerve (IM). We tested three lacerated models using the rabbit’s medial gastrocnemius where the IM was either cut (NNR), repaired (NR), or preserved intact (NP). Muscles were assessed 7 months after repair for muscle atrophy, isometric contraction (by electrical stimulation), and fibrosis formation at the lesion site. Changes in myofibrillar actomyosin adenosine triphosphatase activity, MHC profile, regenerating myofibers and reinnervation were assessed by Western blot, histology, or immunohistology.

RESULTS:
Lacerated muscles with a repaired (NR) or an intact (NP) IM showed good recovery, with no significant changes in the MHC profile. Muscles where the IM was not repaired (NNR) resulted in significant scar area at the lesion site (p < 0.05), muscle atrophy (67%, p < 0.05) and loss in contractile properties (63% of the uninjured side, p < 0.05). At 7 months, all muscles were reinnervated. However, the NNR had an inappropriate (polyneural) and poorly distributed reinnervation, the presence of regenerating myofibers, and demonstrated a fast-to-slow MHC transition (71%:29% to 44%:56%, ANOVA, p = 0.018). This was associated to the cut IM when the NNR muscle was lacerated.

CONCLUSION:
Poor reinnervation in lacerated skeletal muscles alters the myosin heavy chain profile permanently. This study provides a rationale to also consider biological solutions to improve nerve regeneration and reinnervation in the surgical repair of lacerated muscles.

PMID: 20041489
The Cut Intramuscular Nerve Affects The Recovery In The Lacerated Skeletal Muscle


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OBJECTIVE:

The recovery of lacerated skeletal muscles are said to be slow and incomplete. Often the intramuscular (IM-) nerve is concomitantly cut, but never repaired. We questioned whether the IM-nerve should also be reanastamosed before repairing the skeletal muscle. Before answering this, it was necessary to know if the cut IM nerve would have an effect on the recovery of the segment of muscle distal to the level of the laceration. This study investigates the recovery of lacerated muscles after repair, and compares a complete muscle laceration where the main IM-nerve was concomitantly cut and an incomplete muscle laceration where the IM-nerve was preserved intact.

METHODOLOGY:

The medial gastrocnemius (MG) of the adult male New Zealand White rabbit was used, with the contralateral muscle as a sham control. The laceration was at the proximal quarter of the muscle, distal to the entry point of the nerve branch from the tibial nerve into the muscle belly.

RESULTS:

Twenty-eight weeks post-repair, the lacerated MG with the IM-nerve intact showed improved muscle wet weight, near normal morphology and contractile properties, and return of muscle fiber type mix and size. The repaired lacerated MG with their IM-nerve concomitantly cut demonstrated loss of muscle wet weight, obvious fibrosis, mononuclear proliferation with fatty infiltration, increase in type-1 fibers and muscle fiber atrophy in the distal portion.

CONCLUSION:

We postulate that it might be important to repair the intramuscular nerve branch by microanastomosis when repairing a vital skeletal muscle that is lacerated.

PMID: 16419975
Properties Of The Two Neuromuscular Compartments In A Split Bipennate Muscle
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OBJECTIVE:
Bipennate muscles may be split along their distal aponeurosis, dividing each into two compartments. These sub-muscle units may be used in tendon transfers.

METHODOLOGY:
This paper presents the contractile properties of the two sub-units of the flexor carpi ulnaris in a macaca fascicularis, after it was split by up to 80% of its length.

RESULTS:
The sub-muscle units were electrically stimulated and found to have independent isometric contraction, with minimal contraction recorded from the non-stimulated sub-unit. Also, the sum of the forces measured from each unit when stimulated individually, was found to be greater than the force of the whole muscle, given the same isometric conditions. The distal aponeurosis which is common allows force transmission between the compartments.

CONCLUSION:
Splitting the muscle along this distal aponeurosis alters this function and the force capacity of the muscle, providing a new potential for using the sub-units as grafts for tendon transfers.

PMID: 15475216
Microsurgical Skills Training: A New Concept For Simulation Of Vessel-Wall Suturing

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Initiation of training in basic microsurgical suturing technique usually involves placing sutures on incisions made on latex sheets, and then progressing to a live anastomosis in a rat model. A straight incision resembles a skin incision and does not mechanically simulate vessel wall suturing, and various modifications and innovative prosthetic models continue to be developed to bring the simulation closer to a live anastomosis. We developed two models which closely simulate vessel wall suturing and require the application of similar skills by the trainee. In the first model (the "I" model), the straight 1-cm incision is converted to an I-shaped incision which increases the instability of the edge to be sutured, depending on the length of the horizontal incision, putting greater demand on dexterity in suture placement similar to a vessel. The length (1 cm) of the edge does not constrain the spacing of the sutures and can be used for the beginner. The second model (the "double triangle" model) creates a narrow and unstable edge for placing sutures, and puts greater demand on bimanual coordination and instrument control for training in accuracy of suture placement as well as spacing between sutures. Both these models are cost-effective and simple to construct.

PMID: 15643660
Comparison Of Forearm And Conventional Bier’s Blocks For Manipulation And Reduction Of Distal Radius Fractures

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OBJECTIVE:

Forearm-based Bier’s block has been advocated as a useful anaesthetic technique in hand surgery. However, there is limited data comparing forearm blocks with the conventional Bier’s block.

METHODOLOGY:

We conducted a randomised controlled trial (n=30) comparing the two techniques of anaesthesia for manipulation and reduction of closed distal radius fractures in an emergency room setting. Pain scores measured using the Visual Analogue Scale during the procedure were used as the primary outcome assessment.

RESULTS:

There was no significant difference in pain scores between the forearm and conventional Bier’s block (mean VAS 18.4 SD 22.10 versus 33.7 SD 29.6). No major complications were observed in either group.

CONCLUSION:

The forearm-based Bier block is an effective alternative to the conventional block.

PMID: 17123673
Heterodigital Vascular Island Flap For Simultaneous Resurfacing And Revascularization Of Digits

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Devascularized digits with segmental skin and vessel loss require revascularization and resurfacing. This can be addressed by using a heterodigital vascular island flap. This flap brings with it an appropriately sized pristine artery of optimal length for revascularization and provides simultaneous skin cover. We describe 3 cases. Primary wound healing was achieved in all patients with good functional recovery and acceptable donor site morbidity. We compare the options available for reconstructing such defects and discuss other possible surgical indications for this flap.

PMID: 19131716

Dermal Pocketing Following Distal Finger Replantation

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Replantation is an ideal technique for reconstruction following fingertip amputation as it provides 'like for like' total reconstruction of the nail complex, bone pulp tissue and skin with no donor-site morbidity. However, fingertips are often not replanted because veins cannot be found or are thought to be too small to repair. Attempts at 'cap-plasty' or pocketing of replanted tips with and without microvascular anastomosis have been done in the past with varying degrees of success. We prospectively followed up a group of patients who underwent digital replantation and dermal pocketing in the palm to evaluate the outcome of this procedure. There were 10 patients with 14 amputated digits (two thumbs, five index, four middle, two ring and one little) who underwent dermal pocketing of the amputated digit following replantation. Among the 14 digits that were treated with dermal pocketing, 11 survived completely, one had partial atrophy and two were completely lost. Complications encountered included finger stiffness (two patients) and infection of the replanted fingertip with osteomyelitis of the distal phalanx (one patient). We believe that this technique can help increase the chance of survival for distal replantation with an acceptable salvage rate of 85% in our series.

PMID: 19620030
Clinical Outcomes For Patients With Soft Tissue Sarcoma Of The Hand

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OBJECTIVE:
In an earlier report from the current study center regarding surgical treatment for patients with soft tissue sarcoma (STS) of the hand, it was concluded that repeat resection or amputation improves outcomes. Since then, the authors have aggressively sought to achieve negative resection margins, using standard or modified amputations when needed, and performing repeat resections to negative surgical margins when they were not achieved at the time of initial surgery. The current review was conducted to determine whether this approach resulted in better outcomes.

METHODOLOGY:
A retrospective review of 53 patients with STS of the hand who were treated between 1996 and 2005 was performed. Recurrence-free survival (RFS) and functional outcome of hand-preserving procedures were assessed according to the Musculoskeletal Tumor Society (MSTS) system.

RESULTS:
The median RFS was not reached at the time of last follow-up. Of 53 patients, 6 (11%) had positive microscopic resection margins. Three patients underwent repeat resection to negative surgical margins, whereas another 3 patients did not. All 3 patients with positive microscopic surgical margins that were not re-excised developed local disease recurrence; 2 patients also developed distant metastases. Two of the 50 patients with negative resection margins developed distant metastases. All 5 patients who developed local and/or distant disease recurrence had deep tumors. The median MSTS score was 29 (interquartile range, 27-30). Patients who underwent more extensive resections, such as double ray amputations, had lower MSTS scores.

CONCLUSION:
Suboptimal biopsies and positive resection margins are associated with local and distant disease recurrence in patients with STS. The results of the current study suggest that aggressive surgical treatment can result in better clinical outcomes, and underscore that care must be taken when planning biopsies of hand tumors.

PMID: 21235039
Atypical Subtrochanteric Femoral Fractures In Patients With Skeletal Malignant Involvement Treated with Intravenous Bisphosphonates

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OBJECTIVE:
Atypical subtrochanteric femoral fractures have been identified as a potential complication of long-term bisphosphonate therapy for the treatment of osteoporosis. Patients with skeletal malignant involvement, who receive much higher cumulative doses of bisphosphonates than do patients with osteoporosis, may be at higher risk for the development of these fractures.

METHODOLOGY:
A retrospective review of the imaging studies and case notes was done for patients with skeletal malignant involvement who received a minimum of twenty-four doses of intravenous bisphosphonates between 2004 and 2007 and were followed until death or the time of the latest review. Patients were classified as having an atypical subtrochanteric femoral fracture if they had a transverse subtrochanteric fracture following low-energy trauma or an impending fracture, together with radiographic findings of diffuse diaphyseal cortical thickening and cortical beaking at the subtrochanteric area.

RESULTS:
In the study cohort of 327 patients, we identified four patients who developed an atypical subtrochanteric femoral fracture. All four patients were female, three had breast cancer, and one had myeloma. There was no significant difference between patients who developed an atypical subtrochanteric femoral fracture and those who did not with regard to the doses of intravenous bisphosphonates or the duration of treatment.

CONCLUSION:
The prevalence of atypical subtrochanteric femoral fractures in patients with skeletal malignant involvement who are managed with high doses of intravenous bisphosphonates is low. All patients in our study who had development of these fractures had prodromal symptoms of thigh pain.

PMID: 21776577
Single Ray Amputation For Tumors Of The Hand

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OBJECTIVE:
Single ray amputation after hand trauma or infection can result in good aesthetic and functional outcomes. The role of this procedure in the management of aggressive benign or malignant hand tumors has been described only in case reports and small case series.

METHODOLOGY:
We retrospectively reviewed the records of all 25 patients who underwent single ray amputations at our center during a 10-year period; there were seven index, five middle, six ring, and seven small ray amputations performed. The minimum follow-up was 2 months (mean, 36 months; range, 2-120 months), with four patients having a follow-up of 1 year or less. No patients had local recurrences, although two patients had positive resection margins. One underwent repeat resection followed by radiotherapy. The other was treated with radiotherapy alone, as local tumor control would have required a hand amputation.

RESULTS:
Functional assessment based on the Musculoskeletal Tumor Society staging system showed an average of 27.5 (range, 21-30). Patients who underwent perioperative radiotherapy experienced a decrease in functional ability. Grip strength was an average of 66% (range, 38%-100%) of the contralateral side.

CONCLUSION:
Our study suggests single ray amputation for hand tumors has a low local recurrence rate and high functional scores. However, function can be compromised by radiotherapy and a decrease in grip strength by a mean of 34% is to be expected. Level of Evidence: Level IV, case series.

PMID: 19655212
OBJECTIVE:
The dorsal metacarpal artery perforator flap is a versatile solution for resurfacing soft-tissue defects of fingers. The authors present their experience in applying this flap for a variety of finger wounds for which conventional means may not be amenable.

METHODOLOGY:
Fifty-eight dorsal metacarpal artery perforator flaps were used to resurface 60 finger soft-tissue defects in 56 patients over a 5-year period. Fifty-two patients were men and their average age was 37 years. This flap was used to reconstruct soft-tissue defects after débridement of infected wounds in 28 patients, traumatic wounds in 26 patients, and electrical burns in two patients.

RESULTS:
The average flap size was 4.6 × 2.3 cm; 34 flaps were based on the second dorsal metacarpal artery perforator, 14 were based on the third dorsal metacarpal artery perforator, and 10 were based on the fourth dorsal metacarpal artery perforator. Twenty-one flaps were used to resurface defects distal to the proximal interphalangeal joint, and 37 flaps were used to resurface defects over the proximal interphalangeal joint and proximal to it. Skin grafting was needed to close the donor defect in seven patients. Complications included venous congestion in six flaps and arterial insufficiency in three flaps, with total loss of two flaps and infection in one case.

CONCLUSION:
The dorsal metacarpal artery perforator flap is a thin, pliable flap that is simple to raise, has minimal donor-site morbidity, and can reliably cover soft-tissue defects up to the proximal half of the middle phalanx.

PMID: 21865990
A Systematic Review Of The Outcomes Of Replantation Of Distal Digital Amputation

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OBJECTIVE:
The aim of this study was to conduct a systematic review of the English literature on replantation of distal digital amputations to provide the best evidence of survival rates and functional outcomes.

METHODOLOGY:
A MEDLINE search using “digit,” “finger,” “thumb,” and “replantation” as keywords and limited to humans and English-language articles identified 1297 studies. Studies were included in the review if they (1) present primary data, (2) report five or more single or multiple distal replantations, and (3) present survival rates. Additional data extracted from the studies meeting the inclusion criteria included demographic information, nature and level of amputation, venous outflow technique, nerve repair, recovery of sensibility, range of motion, return to work, and complications.

RESULTS:
Thirty studies representing 2273 distal replantations met the inclusion criteria. The mean survival rate was 86 percent. There was no difference in survival between zone I and zone II replantations (Tamai classification). There was a significant difference in survival between replantation of clean-cut versus the more crushed amputations (crush-cut and crush-avulsion). The repair of a vein improved survival in both zone I and zone II replantation. The mean two-point discrimination was 7 mm (n = 220), and 98 percent returned to work (n = 98). Complications included pulp atrophy in 14 percent of patients (n = 639) and nail deformity in 23 percent (n = 653).

CONCLUSION:
The common perception that distal replantation is associated with little functional gain is not based on scientific evidence. This systematic review showed a high success rate and good functional outcomes following distal digital replantation.

PMID: 21572379
Reconstruction Of Digital Deformities In Rheumatoid Arthritis

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Digital deformities result from rheumatoid synovitis. These deformities are easier to treat in the early stage, when the deformity is passively correctable. Treatment options become limited as the disease progresses and the deformity becomes fixed. Surgical treatment of digital deformities is last in the priority of surgical procedures for the rheumatoid hand and wrist. It is therefore important to understand the patient’s needs and expectations for improvement and attempt to match them with the surgical options that can predictably improve the patient’s function. A close collaboration with the patient’s rheumatologist is helpful in the overall management of patients.

PMID: 21176804

Planning Correction Of The Varus Ankle Deformity With Ankle Replacement

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Ankle replacement in the presence of a varus deformity is an evolving field. Although the initial results were disappointing, numerous advances in the understanding of the condition and operative techniques have been made. More recent reports show good short-term results, especially when adjunctive procedures are combined, not only to achieve a neutral alignment but also to restore lateral ligamentous stability. As a result, it is possible to correct varus deformities of 20° or more with ankle replacement. It is likely that, with a reliable correction of alignment and balance, that the long-term results of ankle replacement in significant varus deformity will be promising.

PMID: 22284555
Curve Progression In Idiopathic Scoliosis: Follow-Up Study To Skeletal Maturity

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OBJECTIVES:
The natural history of idiopathic scoliosis is not well understood. Previous reports have focused on the characteristics of curve progression where progression has been predefined at specific angles of 5 degrees to 6 degrees. However, the absolute curve magnitude at skeletal maturity is more predictive of long-term curve behavior rather than curve progression of a defined magnitude over shorter periods of skeletal growth. It is generally agreed that curves less than 30 degrees are highly unlikely to progress after skeletal maturity. Hence, defining the factors that influence curve progression to an absolute magnitude of more than 30 degrees at skeletal maturity would more significantly aid clinical practice. This study aims to identify the prognostic factors for curve progression to a magnitude of 30 degrees at skeletal maturity in skeletally immature patients with adolescent idiopathic scoliosis.

METHODS:
This is a follow-up study to skeletal maturity on a cohort of students screened for a 1-year prospective epidemiological prevalence study for scoliosis. One hundred eighty-six patients who fulfilled the study criteria were selected from an initial 279 patients with idiopathic scoliosis detected by school screening, and who were followed-up till skeletal maturity. The initial age, gender, pubertal status, and initial curve magnitude were used as risk factors to predict the probability of curve progression to more than 30 degrees at skeletal maturity.

RESULTS:
Curve magnitude at first presentation was the most important predictive factor for curve progression to a magnitude of more than 30 degrees at skeletal maturity. An initial Cobb angle of 25 degrees had the best receiver-operating characteristic of 0.80 with a positive predictive value of 68.4% and a negative predictive value of 91.9% for curve progression to 30 degrees or more at skeletal maturity.

CONCLUSION:
Initial Cobb angle magnitude is the most important predictor of long-term curve progression and behavior past skeletal maturity. We suggest an initial Cobb angle of 25 degrees as an important threshold magnitude for long-term curve progression. Initial age, gender, and pubertal status were less important prognostic factors in our study.

PMID: 1933310
OBJECTIVE:
To report our results of open reduction internal fixation with volar mini plate and screw fixation for unstable dorsal fracture dislocations (DFDs) of the proximal interphalangeal (PIP) joint.

METHODOLOGY:
We performed a retrospective review of 13 consecutive DFDs of the PIP joint treated with volar mini plate and screw fixation, measuring both clinical and radiological outcomes.

RESULTS:
The age range of our patients was 15 to 56 years (average, 33 y). Six injuries were related to work, 5 to sports, and 2 to motor vehicle accidents. Of the 13 DFDs, 6 were comminuted. Articular involvement ranged from 30% to 70% (average, 44%). The average time to surgery was 7 days (range, 0-23 d). Patients had follow-up of 12 to 60 months (average, 25 mo). Four patients had a postoperative course complicated by plate and screw removal at an average of 4 months later, either as part of a secondary procedure to improve range of motion or owing to patient request. All patients returned to their original occupation. Of the 13 patients, 11 were satisfied with the result, and 12 of 13 had either no or mild pain. All 13 DFDs united in good alignment but 3 showed degenerative changes. Average grip strength was 85% of the unaffected side, and average active PIP joint and distal interphalangeal joint motion arcs were 75° and 65°, respectively. Average Quick Disabilities of Arm, Shoulder, and Hand score was 4 (range, 0-9). All patients had non-tender swelling of the proximal interphalangeal joints but no signs of flexor tenosynovitis or infection.

CONCLUSION:
Fixation of unstable PIP joint DFDs via a volar approach is technically feasible with mini plates and screws. This treatment allows early active range of motion and provides good objective and subjective outcomes; however, noteworthy complications occurred in 39% of patients.

TYPE OF STUDY/LEVEL OF EVIDENCE: Therapeutic IV.

PMID: 22018477
Bites To The Hand: Are They More Than We Can Chew?
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Animal bites to the hand caused by dogs, cats and humans are common conditions that general practitioners, emergency physicians and hand surgeons encounter in their practice. These bites are prone to infection and represent great cost to the patient in terms of time, money and disability, if not treated optimally from the outset. Other than lacerations to the skin, injuries to the tendons, nerves, bone and joints are commonplace given their proximity to the skin surface in the hand. Optimal treatment of acute animal bites to the hand should include clearance of contamination by surgical debridement, prophylactic antibiotics and tetanus toxoid, as well as staged reconstruction of all damaged tissue, including the skin, once the wound is deemed clean.

PMID: 22009389

Discriminative Segmentation Of Microscopic Cellular Images
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Microscopic cellular images segmentation has become an important routine procedure in modern biological research, due to the rapid advancement of fluorescence probes and robotic microscopes in recent years. In this paper we advocate a discriminative learning approach for cellular image segmentation. In particular, three new features are proposed to capture the appearance, shape and context information, respectively. Experiments are conducted on three different cellular image datasets. Despite the significant disparity among these datasets, the proposed approach is demonstrated to perform reasonably well. As expected, for a particular dataset, some features turn out to be more suitable than others. Interestingly, we observe that a further gain can often be obtained on top of using the “good” features, by also retaining those features that perform poorly. This might be due to the complementary nature of these features, as well as the capacity of our approach to better integrate and exploit different sources of information.

PMID: 22003672
Recurrent Patellar Dislocation: Reappraising Our Approach To Surgery

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OBJECTIVE:
The management of recurrent traumatic patellar dislocation includes surgical realignment. There is no clear distinction whether proximal soft tissue or distal procedures produce superior results. However, distal realignment procedures are commonly associated with greater morbidity. We advocate a distal procedure only for cases which are more severe, such as the presence of patellar maltracking.

METHODOLOGY:
Between January 2002 and June 2007, all patients who had a history of traumatic patellar dislocation with recurrent symptoms and failed conservative management underwent surgical realignment. Patients who had evidence of lateral patellar subluxation on computed tomography (CT) scan were offered a distal realignment procedure using the Elmslie-Trillat or Roux Goldthwaite procedure. All other patients underwent proximal soft tissue medial patella femoral ligament (MPFL) reconstruction. Pre and postoperative functional International Knee Documentation Committee (IKDC), Lysholm and Tegner score assessments were performed for a minimum follow-up period of 6 months. The mean scores for each group were analysed using the Wilcoxon Matched-Pairs Signed-Ranks test and the Mann-Whitney U test was used to evaluate the difference between the groups.

RESULTS:
A total of 23 patients underwent surgery for patellar realignment. Of whom, 14 patients had a distal realignment procedure while 9 patients had a proximal procedure of MPFL reconstruction. There was greater morbidity reported with distal realignment procedures. Pre and postoperative IKDC, Lysholm and Tegner scores showed significant improvement for both treatment arms. However, there was no significant difference between the improvement scores for both groups.

CONCLUSION:
Patients with significant patellar maltracking following traumatic patellar dislocation would benefit from distal realignment using the Elmslie-Trillat or Roux Goldthwaite procedure. Otherwise, a proximal soft tissue procedure involving MPFL reconstruction would be adequate. A management algorithm is proposed for clinical use.

PMID: 18461217
Radial Neck Fractures In Children

Bryan Hsi Ming Tan, Arjandas Mahadev

OBJECTIVE:
To review records of 108 children with radial neck fractures and develop an algorithm for treatment.

METHODOLOGY:
Records of 50 girls and 58 boys aged 2 to 14 (mean, 8.7) years with radial neck fractures were reviewed. The most common injury mechanism was tripping and falling on an outstretched hand while running (n=44), followed by falling from monkey bars (n=11). Fractures were classified into grade 1 (n=25), grade 2 (n=60), grade 3 (n=16), grade 4a (n=6), and grade 4b (n=1). 21 patients had associated fractures involving the olecranon, proximal ulna, and/or the humeral supracondyle. The time from injury to treatment ranged from 0 to 7 days. Treatments included casting without manipulation (n=86), closed reduction and casting (n=8), percutaneous Kirschner wire–assisted reduction and casting (n=7), and open reduction and casting (n=7).

RESULTS AND CONCLUSION:
Patients were followed up for a mean of 2.7 (range, 1–5) years. Outcome was excellent in 93 patients, good in 11, and fair in 4. Higher fracture grades correlated positively with poorer outcomes (p=0.001) and more invasive treatment (p=0.001). Nonetheless, the post-reduction angles of all the patients were not significantly different (p>0.05). Older children sustained more severe fractures (p=0.04) and had poorer outcomes, even after correction for fracture grade (p=0.007). Patients with associated fractures had significantly poorer outcomes (p<0.05). Two patients developed synostosis of the proximal radioulnar joint. One of whom had an associated olecranon fracture and underwent open reduction and casting. The other had an associated proximal ulnar fracture and underwent repeated percutaneous Kirschner wire–assisted reduction owing to loss of reduction. Five patients developed heterotopic ossification. Four of whom had associated fractures (3 involved the olecranon and one the proximal ulna). 14 patients developed cubitus valgus deformity of 3° to 10°. Conclusion. Open reduction should only be performed after more conservative treatments fail to achieve reduction.

PMID: 21857047
OBJECTIVE:
Current studies mainly focus on the changes in the IVD in response to degeneration and regeneration. However, the basic science regarding degenerative changes of the vertebral endplate and its actions on the IVD is lacking. The endplate is responsible for nutrient flow to the IVD through diffusion. It has been postulated that changes in the endplate may be responsible for the degeneration of the IVD. We aim to assess the histologic features and vascularization of the endplate after axial compression and distraction, along with the degeneration and regeneration status of IVD.

METHODOLOGY:
An in vivo study of the rabbit's endplate and intervertebral disc (IVD) was conducted. Twenty New Zealand white rabbits were equally divided into 4 groups as follows; group A, 28 days of compression only; group B, 28 days of disc compression followed by 28 days of unloading; group C, 28 days of disc compression followed by 28 days of distraction; and group D, sham operated animals with apparatus placement only. At the end of the study, all the animals in the 4 groups were killed and the lumbar segments harvested for analysis of their disc height, vascularity, and histologic examination.

RESULTS:
Compression decreased the disc height and the rabbits showed signs of disc degeneration. Ossified endplates with decreased cells and extracellular matrix, and decreased vascular channel volume were observed. Cellular and morphologic regeneration were observed on unloading and distraction of the compressed discs, although the cartilaginous endplates were partially ossified. The volume of vascular channels increased significantly after distraction. Fluorescent vascular tracer showed the presence of active blood flow in the vascular channels near the cartilaginous endplates.

CONCLUSION:
Compression resulted in degeneration of the cartilaginous endplate and decrease in the osseous endplate vascular channel volume, both of which led to the degeneration of the IVD. Unloading and distraction allowed the regeneration of the extracellular matrix in both the endplate and the recovery of vascular channels.

PMID: 20975621
OBJECTIVE:

The results of surgical treatment for tarsal tunnel syndrome have been suboptimal, especially in the absence of space-occupying lesions. We attribute this to a poor understanding of the detailed anatomy of the ‘tarsal tunnel’ and potential sites of nerve compression.

METHODOLOGY:

This study involved the dissection of 19 cadaver feet. All findings and measurements were documented with still digital photography and digital calipers.

RESULTS:

This study demonstrates three well-defined, tough fascial septae in the sole of the foot. In addition to the flexor retinaculum and the abductor hallucis, two of these septae represent potential sites of compression of the posterior tibial nerve and its branches. The flexor retinaculum is a common point of compression for the posterior tibial nerve and its branches. The medial and lateral plantar nerves may be compressed beneath the fascial origin of the abductor hallucis and the muscle itself. The medial plantar nerve may be entrapped under the medial septum. However, in the 16 out of 19 feet, the medial plantar nerve skirted and did not traverse beneath the septum. The lateral plantar nerve traversed beneath the medial septum in all specimens. The nerve to abductor digiti minimi may be trapped under the medial and intermediate septum.

CONCLUSION:

A better understanding of the anatomical relationships of the tarsal tunnel and a clear communication system among anatomists, neuroradiologists and foot and ankle surgeons will facilitate accurate preoperative localization of the site of nerve compression and possibly selective surgical releases, leading to better outcomes and minimal morbidity.
Common Lower Limb Sport-Related Overuse Injuries In Young Athletes

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OBJECTIVE:
Sports injuries in children and adolescent present a unique challenge to the physician. They are often seen for clinical conditions unique to their age group. This paper highlights the epidemiological aspect of sports-related overuse injuries in this age group.

METHODOLOGY:
This retrospective study reviewed all the paediatric patients diagnosed with overuses injuries during a 5 years and 7 months period. The overuse injuries were anterior superior iliac spine avulsion fracture, Osgood-Schlatter disease, Sinding-Larson-Johansson disease, osteochondritis dissecans and Sever’s disease. We reviewed the literature and attempted to give an overview for each condition and the anatomical differences that contributed to their occurrence in this age group.

RESULTS:
A total of 506 cases of the overuse injuries were seen during the study period. Seventy-three per cent were male patients. The knee joint was the commonest affected joint while the hip was the least affected joint. The mean age at diagnosis was younger in female compared to male for all conditions except in Sinding-Larson Johansson syndrome. Female was diagnosed at a mean age of 11.7 years while male at 10.8 years. Osgood-Schlatter disease was the commonest among the overuse injuries. There was no discernible racial predilection for these conditions except in the patients with anterior superior iliac spine avulsion.

CONCLUSION:
Overuse injuries are not uncommon in children and adolescent. An adequate understanding of the anatomy of the sports the children participated in as well as the anatomical differences between adult and children may assist the primary care providers better meet parents’ and coaches’ expectations.

PMID: 18461216
Deep Peroneal Nerve Entrapment By A Spiral Fibular Fracture: A Case Report

Hey HW, Tan TC, Lahiri A, Wilder-Smith EP, Kumar VP, Kagda FH, Lim AY.

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Nerves adjacent to bones are prone to injury caused by fractures and fracture fixation. Nowhere is this more true than in the proximal fibular region, where the common peroneal nerve winds around the fibular neck. To our knowledge, despite the close proximity of the common peroneal nerve to the neck of the fibula, no instances of common or deep peroneal nerve palsy caused by indirect trauma have been reported in the literature. We describe a rare case of nerve entrapment associated with a spiral fracture of the proximal part of the fibula that resolved after neurolysis. The patient’s family was informed that data concerning the case would be submitted for publication, and they provided their consent.

PMID: 22005874

Demographics And Clinical Presentation Of Slipped Capital Femoral Epiphysis In Singapore: Comparing The East With The West

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This study examines the demographics and clinical presentation of slipped capital femoral epiphysis in Singapore. Sixty-six patients (53 boys, 13 girls) with 77 involved hips were reviewed retrospectively. Local prevalence was 1.2/100,000 children. Twenty-four patients were Chinese, 12 were Malay, 27 were Indians, and three patients were Eurasians. A total of 76.6% of patients above the 90th percentile for body weight were present; 16.7% of patients had bilateral involvement. Seventeen patients had endocrine-related problems. We had a high male preponderance, and a disproportionately high number of Indian patients. A high proportion of patients were obese. Our incidence of bilateral involvement seems to be higher than our Indonesian neighbors. The differences seen may be due to genetic and sociocultural variations.

PMID: 18841061
Differentiation Of Bone Marrow-Derived Mesenchymal Stem Cells Into Multi-Layered Epidermis-Like Cells In 3D Organotypic Coculture

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The interactions of bone marrow-derived mesenchymal stem cells (MSCs) and their engrafted microenvironment are an integral part of signaling control of stem cell lineage commitment. We attempted to induce bone marrow-derived MSCs to undergo epidermal lineage differentiation by manipulating the biochemical, environmental and physical properties of culture conditions in an organotypic coculture model to simulate a skin-specific microenvironment. The induction medium was optimized by varying different biomolecular supplements in a basic stratification medium. A multi-layered epidermis-like structure was established when MSCs were cultured in an optimized induction medium on a contractible fibroblast-embedded collagen gel with an air-liquid interface. The commitment into epidermal lineage was further confirmed by the expression of early and intermediate epidermalization markers - keratin 10 and filaggrin in 90.67% and 80.51% of MSCs, respectively. This study not only highlights the possibility of in vitro control of MSCs into epidermal lineage, but also suggests the therapeutic potential of bone marrow-derived MSCs for skin regeneration.

PMID: 19285341

Early Adhesive Behavior Of Bone-Marrow-Derived Mesenchymal Stem Cells On Collagen Electrospun Fibers

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A bioabsorbable nanofibrous scaffold was developed for early adhesion of mesenchymal stem cells (MSCs). Collagen nanofibers with diameters of 430 +/- 170 nm were fabricated by electrospinning. Over 45% of the MSC population adhered to this collagen nanofiber after 30 min at room temperature. Remarkably, collagen-coated P(LLA-CL) electrospun nanofibers were almost as efficient as collagen nanofibers whereas collagen cast film did not enhance early capture when it was applied on cover slips. The adhesive efficiency could be further increased to over 20% at 20 min and over 55% at 30 min when collagen nanofibers were grafted with monoclonal antibodies recognizing CD29 or CD49a. These data demonstrate that the early adhesive behavior is highly dependent on both the surface texture and the surface chemistry of the substrate. These findings have potential applications for early capture of MSCs in an ex vivo setting under time constraints such as in a surgical setting.

PMID: 19439824
Effects Of Mechanical Stimulation In Osteogenic Differentiation Of Bone Marrow-Derived Mesenchymal Stem Cells On Aligned Nanofibrous Scaffolds

Michell Ngiam, Susan Liao, Timothy Jie, Sui Xiaodi, Yxiang Dong, S Ramakrishna, Casey K Chan

Mechanical stimulation is one of the factors that regulating bone regeneration and healing. In this study, the biological responses of bone marrow derived mesenchymal stem cells (MSCs) to mechanical stimuli on aligned nanofibers and cast films were investigated. The uniaxial cyclic strain (1% strain and 1 Hz) was applied continuously to the cell substrates and osteoblastic activities were assessed at weeks 1, 2, and 4. The MSCs morphology on the aligned nanofibers was more elongated and spindle-like than MSCs on the cast films. Strain stimulation significantly attenuated the proliferation at week one but was significantly enhanced at week 4 for both types of substrates. Only the MSCs on strained nanofibers had greater alkaline phosphatase (ALP) levels at week one, while the ALP hindered the MSCs on both substrates at week 4. Strain application played a greater influence on osteocalcin expression for the cast films than the nanofibers at week 4. Clearly, the cellular response to strain induction was highly dependent on the surface–cell adhesion, which itself was greatly influenced by the surface texture of the substrate.

The Use Of Muscle Flaps In The Salvage Of Infected Exposed Implants For Internal Fixation

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The treatment of infected exposed implants which have been used for internal fixation usually involves debridement and removal of the implant. This can result in an unstable fracture or spinal column. Muscle flaps may be used to salvage these implants since they provide soft-tissue cover and fresh vascularity. However, there have been few reports concerning their use and these have concentrated on the eradication of the infection and successful soft-tissue cover as the endpoint. There is no information on the factors which may influence the successful salvage of the implant using muscle flaps. We studied the results and factors affecting outcome in nine pedicled muscle flaps used in the treatment of exposed metal internal fixation with salvage of the implant as the primary endpoint. This was achieved in four cases. Factors predicting success were age < 30 years, the absence of comorbid conditions and a favourable microbiological profile. The growth of multiple organisms, a history of smoking and the presence of methicillin-resistant Staphylococcus aureus on wound cultures indicated a poor outcome. The use of antibiotic beads, vacuum-assisted closure and dressing, the surgical site, the type of flap performed and the time from primary surgery to flap cover were not predictive of outcome.

PMID: 20190312
WORK IN PROGRESS
Sodium Chloride (NaCl) Increases Antibiotic Elution From Acrylic Bone Cement For Enhanced Infection Prophylaxis
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OBJECTIVES
To investigate the effects of a porosity-increasing additive, sodium chloride (NaCl), on bone cement antibiotic elution and biofilm formation

METHODOLOGY
Commercially available gentamicin-loaded bone cement were used. 3 different forms of cement samples were prepared: plain without antibiotics, gentamicin-loaded (GLBC), gentamicin-loaded with addition of 10% w/w of NaCl (GLBC-NACL). NaCl was used as a porosity-increasing and antibiotics release modulator. 2 clinical strains of Staphylococcus Aureus (ATCC 12600/ 7388) were used. Osteoblastic MC3T3 cells were used for proliferation studies.

Gentamicin release study was conducted using spectrophotometric analysis to evaluate the duration and amount of antibiotic elution from bone cement samples. Bacterial biofilms were stained with 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT), BacLight Viability Stain and Calcofluor White (Dapi). Absorptive values indicating biofilm activity were determined by spectrophotometric analysis. Bacterial activity was assessed with IVIS bioluminescence. Biofilms were visualized by confocal laser scanning microscopy. Inhibition zones were determined for each bone cement sample. Mechanical analysis of bone cement samples was performed. At least 3 samples per time point for each experimental condition were used. One-way analysis of variance (ANOVA) post-hoc Turkey test was used to analyse the data. Statistical significance was accepted at P < 0.05.

RESULTS
Gentamicin release was comparable for both GLBC and GLBC-NaCl in the first 48 hours. Thereafter, gentamicin concentrations plateau-ed in GLBC samples. Sustained gentamicin release beyond 48 hours was observed in GLBC-NaCl samples due to increased porosity. Lower bacteria density in GLBC-NaCl was observed with IVIS. Slime production was also significantly decreased. Ratio of live:dead bacteria was significantly lower in GLBC-NACL. Inhibition zones were significantly larger in GLBC-NaCl samples compared to GLBC/control samples. Osteoblastic proliferation was not affected by the addition of NaCl. Mechanical properties were reduced by the increased porosity from NaCl addition, but remained above acceptable limits for the structural integrity of bone cement.

CONCLUSION
NaCl enhances both the duration and extent of antibiotic elution from bone cement. The results suggest that NaCl-modified, gentamicin-loaded bone cements are promising candidates for use in various orthopaedic and dental applications for enhanced infection prophylaxis.
Outcome Of Total Knee Arthroplasty In Obese Patients
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OBJECTIVES

1. Explore the differences between obese and non-obese patients at baseline prior to total knee arthroplasty.
2. Compare objective and subjective clinical outcomes in both groups of patients after total knee arthroplasty.
3. Identify key aspects in the management of the obese patient so that the outcome of surgery can be optimized.

METHODOLOGY

We prospectively analyzed all consecutive patients who underwent total knee arthroplasty in a tertiary university centre from December 2008 to July 2009. The patients were grouped according to their pre-operative body mass index (BMI) as follows: non-obese (BMI < 30 kg/m$^2$) and obese (BMI ≥ 30 kg/m$^2$). Demographic variables of age, gender, co-morbidity and knee alignment were retrieved. Intra-operative indices such as duration of operation, patella resurfacing, implants type and usage of navigation were also analysed. Pre-operative and one-year post-operative Western Ontario McMaster University Osteoarthritis Index (WOMAC) score, Knee Society Score, Short Form 36, patient satisfactory survey and range of movement (ROM) were compared across patients. Linear regression modelling was used to evaluate the effects of baseline clinical characteristics in predicting post-operative changes in the WOMAC, KSS, SF 36 scores and ROM.

RESULTS

There were a total of 142 patients with 39 obese patients and 103 non-obese patients. There were no significant differences in patient characteristics except significantly higher proportion of hypertensives (87.2 vs. 64.1, p = 0.007) and varus- (87.2 vs. 66, p=0.012) aligned knees in the obese population. There was also no difference in intra-operative indices. Both obese and non-obese groups obtained statistically significant improvements in clinical scorings and ROM post-operatively (P<0.001). Pre-operative maximum extension, KSS scores, WOMAC scores and SF36MCS were similar between obese and non-obese patients. The non-obese group has significantly superior pre-operative ROM and SF36PCS (p < 0.05). This superior range of movement in non-obese group is maintained post-operatively, but the SF36PCS is similar between the 2 groups post-operatively (Figure 1 and 2). Post-operatively, the non-obese group also attained superior KSS Function scores and maximum flexion (p<0.05). There was significantly more improvement in the non-obese group in KSS function score (p = 0.017). Absolute improvements in other clinical scorings and range of movement were not significant.

Linear regression analysis taking into account patient characteristics, intra-operative indices and corresponding pre-operative clinical scoring, pre-operative ROM continue to show significantly more improvement in non-obese group than the obese group in KSS function score (p=0.002). Absolute improvements in other clinical scorings and range of movement were not significant.

The most common post-operative complications were deep vein thrombosis, wound infection and cardiac events. We found a non-significant trend towards higher rates of DVT, wound infection and cardiac complications in the obese group. Mean length of stay was significantly higher in obese patients than non-obese patients (7.77 vs. 6.29, p = 0.043).

CONCLUSION

Total knee arthroplasty is a safe and efficacious operation in obese patients with no significantly greater risk of complications. However, post-operative clinical scores and absolute improvements in the scores are statistically superior in non-obese patients at one year follow-up.
Unipolar Versus Bipolar Hemiarthroplasty For Displaced Femoral Neck Fractures In The Elderly: Is There A Difference?

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OBJECTIVE

Hip hemiarthoplasties are commonly performed for displaced femoral neck fractures. However, the choice between unipolar and bipolar designs remains unclear. This retrospective study aims to compare the outcomes between the unipolar (Moore's) and bipolar hemiarthroplasty to assess functional outcome and the incidence of long term complications such as acetabular erosion, dislocation and revision.

METHODOLOGY

Inclusion criteria were (a) age more than or equal to 65 years, (b) displaced femoral neck fracture of non-pathologic origin, (c) normal cognitive function, (d) ambulatory with or without assistive devices prior to the fracture, and (e) treated with a primary prosthetic replacement. Patient characteristics examined included age, gender, prefracture ambulatory status, and number of associated comorbidities. Postoperatively, patients were assessed with regards to pain, satisfaction, Modified Harris hip score and Oxford hip score. Standard anteroposterior pelvis and lateral hip radiographs were obtained at regular intervals. These were analysed specifically with regards to acetabular erosion and component migration.

RESULTS

Between 1 January 2004 and 31 December 2007, 317 patients underwent hemiarthroplasty for displaced neck of femur fracture. Of these, a total of 270 patients met the selection criteria and were included in this study; 164 patients received a Moore's and 106 patients received a bipolar prosthesis. At the time of review, 38 patients were lost to follow-up and 39 patients had died. A minimum of 2 years of follow-up was available for 193 of the surviving patients who were available for review; 118 in the Moore's group and 75 in the bipolar group. Mean age at time of operation was 73.7 years (range, 65 to 85). Mean duration of follow-up was 4.1 years (range, 2.1 to 5.2). Clinical outcome in terms of patient satisfaction, Modified Harris Hip score and Oxford Hip score did not differ significantly. There were no statistically significant differences regarding the radiographic findings as well.

CONCLUSION

The theoretical advantages of a bipolar prosthesis over a unipolar prosthesis is not supported by evidence. Hence, the additional costs incurred with the use of a bipolar prosthesis in the elderly with displaced neck of femur fracture is not warranted.
Clinical Outcomes Of Below Knee Amputations In Diabetic Foot Patients

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OBJECTIVE

To evaluate the predictive factors affecting the clinical outcome of Below Knee Amputations (BKA) performed in diabetic foot patients admitted to National University Hospital (NUH) Multi-Disciplinary Diabetic Foot Team.

METHODOLOGY

This is a prospective cohort study of 151 patients admitted to the Department of Orthopaedic Surgery, NUH, for Diabetic Foot Problems (DFP) from January 2006 to January 2010. All had undergone BKA performed by NUH Multi-Disciplinary Diabetic Foot Team. Statistical analyses (univariate and multivariate analysis with logistic regression) were carried out using SPSS version 18.0, for factors such as demographic data, diabetic duration and control, clinical findings and investigations, indications for surgery, pre-operative investigations and evaluation, microbiological cultures, and these were compared to the clinical outcome of the patient. A good clinical outcome is defined as one not requiring proximal amputation and whose stump healed well within 6 months. Statistical significance was set at p < 0.050.

RESULTS

Mean age of study population was 55.2 years with a male to female ratio of about 3:2. Mean follow up duration was 36 months. 73.5% of BKAs gave a good outcome. Univariate analysis showed that high Total White Count (TW), Erythrocyte Sedimentation Rate (ESR), C-Reactive Protein (CRP), Urea, Creatinine (Cr), Neutrophils, absence of posterior tibial and popliteal pulses, low Ankle Brachial Index (ABI) and Toe Brachial Index (TBI) were associated with poor clinical outcome. Multivariate analysis showed that high ESR, Neutrophils, and low ABI were associated with poor clinical outcome. Mortality rate was 21.2% within 6 months of operation, with sepsis being the most significant cause of death. Univariate analysis showed that patients with End Stage Renal Failure (ESRF), previous stroke (CVA), higher Urea and Cr levels, absence of pulses (dorsalis pedis, posterior tibial, popliteal), abnormal perfusion and capillary filling, presence of neuropathy and poor ASA status were associated with mortality. Multivariate analysis showed that high ASA status and absence of popliteal pulse were associated with mortality.

CONCLUSION

Success rate of BKA was 73.5%, with mortality rate being 21.2% within 6 months. High ESR, Neutrophils and low ABI were associated with poor clinical outcome, and High ASA status and absence of popliteal pulse were predictive factors of mortality.
HEALTH MANPOWER DEVELOPMENT PROGRAMME
HMDP FELLOWSHIPS
A Year of Learning in Manchester

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It was a unique and enriching experience to spend a year in Manchester under the supervision of Professor DA McGrouther, an internationally renowned surgeon, with unique contributions to the field of Hand Surgery as well as basic science. He divides his time between the University Hospital of South Manchester (UHSM) and the Department of Plastic Surgery Research at the Manchester University.

Attending Professor McGrouther’s clinic sessions was a pleasure. I was exposed to a variety of Hand Surgery cases. Professor McGrouther examined each case in detail before taking time to discuss the management plan with the trainees.

In the operating theatre it was, again, a very enriching experience operating with Professor McGrouther. There was no cook-book surgery. The surgical plan was tailored to the individual patient, based on the analysis of the pathophysiology and the pathologic anatomy in each case.

I enrolled in a Master of Research (MRes) in ‘Tissue Engineering and Regenerative Medicine’, a one-year comprehensive course. The teaching modules included ethics, research methodology, biomaterials, stem-cell biology and tissue engineering, presented by experts in their respective fields. The course also included a dissertation based on a six-month-long basic science project.

The project was carried out under the supervision of Professor McGrouther, and co-supervised by Dr Jason KF Wong, Clinical Lecturer in Plastic Surgery, a very keen and enthusiastic researcher.

I worked on in-vivo tissue engineering, exploring the behaviour of a vascular pedicle in an isolated environment, and the modulation of tissue behaviour using exogenous fibrin matrix and bone morphogenetic protein. During laboratory work, I acquired competence in small animal anaesthesia, small animal surgery, immunohistochemistry, photomicrography, and imaging techniques. In addition, I also completed a course on cell culture techniques.

As part of the Master of Research course, we attended lectures given by experts in tissue engineering from all over UK. This gave us a wide exposure to cutting edge research in the field of tissue engineering.
The Nobel experience

The year when the Nobel Prize in Physics went to Manchester:

It was an exciting year for the University of Manchester when two of Manchester University's scientists were awarded the Nobel Prize in Physics for the discovery of ‘Graphene’, the only one dimensional solid structure so far.

Andre Geim (left) and Konstantin Novoselov (right) and Graphene!

Nobel Prize Lectures: I had the unique opportunity to attend a lecture by Professor Tim Hunt, through the AstraZeneca Nobel Medical Initiative. The lectures were open to all university staff and students free of charge. It was an experience to interact with one of the most brilliant minds in science.

Poster for the event and Professor Tim Hunt engaging eager students in a light hearted discussion
Conferences

I also attended the meetings and conferences under the British Society of Surgery for the Hand.

AlQattan and Hong Chi Chen in an animated discussion while David Stuart, President of the British Society of Surgery for the Hand (on stage), and Professor McGrouther (behind podium) try to moderate!

London hosted another kind of convention, the international Cosplay convention – a treat for anime fans!

The scale of the London Cosplay convention, and close encounters with the delegates.

Thanks to the HMDP funding and a kind and capable mentor (Professor McGrouther), I had an intellectually stimulating year in Manchester, completed the Master of Research in Tissue Engineering and gained new perspectives in science and basic science research.
Fellowship in Foot and Ankle Surgery

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Two fellowships in two continents

I spent 6 months from March 2010 to September 2010 in Germany, pursuing a fellowship at the University Hospital Carl Gustav Carus in Dresden under Professor Hans Zwipp. I then spent a separate 6 months in the USA, completing a fellowship at the Institute of Foot and Ankle Reconstruction under Dr Mark Myerson.

Dresden, Germany

Dresden is a beautiful, historic German city. It is located near the German-Czech Border and along the river Elbe. The city was bombed extensively in World War II, but has since been reconstructed to its former glory. The people here pride themselves in particular on the reconstruction of the Frauenkirche or ‘Church of Our Lady’, which was rebuilt using the rubble from the destroyed church. The University Hospital Carl Gustav Carus is the main tertiary hospital in the city. I was attached to the Traumatology Department, which in Germany, takes care of all Orthopaedic Trauma, both acute and subacute. This includes sports injuries such as meniscus tears and ACL tears. There was a separate Orthopaedic Department, which mainly performed arthroplasty. On average, I spent 3 days a week in the Operating Room and 2 days in the ‘sprechstunde’ or outpatient clinic. Professor Hans Zwipp, whom I got to know well over the 6-month period, is the Head of the Department. He is an amazing man who has dedicated his life to the advancement of Foot and Ankle trauma and deformity. He has a gentle manner in his treatment of all his patients, staff and fellows.

Baltimore, Maryland, USA

The Institute of Foot and Ankle Reconstruction is a set-up comprising of four full-time attending foot and ankle surgeons. During my fellowship, my exposure was concentrated mainly on elective reconstruction of the foot and ankle. Dr Mark Myerson, the Director, is an extremely dynamic individual who was always doing multiple things at any one time. What struck me most was the dedication to education that was possible even in a ‘private’ medical institute. Our team was smaller than the one in Germany, as there were no residents. There were only surgical partners and four fellows. Fellows were expected to run the twice-weekly pre-operative meetings and case discussion sessions. There were also fellow teaching sessions every Wednesday afternoon and a monthly combined Foot and Ankle Journal Club with Union Memorial Hospital. In addition, every fortnight, Dr Myerson would conduct a teaching session where all fellows were invited to his home for a home cooked dinner followed by a lecture on a selected topic.
I was fortunate that during the period I was there, the AOFAS Foot and Ankle Complications Course, chaired by Dr Myerson, took place in Baltimore. This provided excellent opportunities for learning and meeting other foot and ankle fellows in USA as well as foot and ankle surgeons from other countries.

**Summary**

I thoroughly enjoyed my one year HMDP in both countries. I have benefitted a great deal from the clinical experience I was taught. I also forged long-term relationships with the surgeons and staff both in Germany and the USA.
I was standing in the long winding queue waiting for entry tickets at the Palace of Versailles, Paris in June 2011, when I suddenly heard a loud voice saying ‘Go Blue’ and I instinctively responded ‘Go Blue’ even before I had an opportunity to see where the voice came from….It is then I realized that I was wearing a University of Michigan T-shirt and there was another Michigan alumnus in the queue….navy blue and bright yellow are the official colours of the University of Michigan (UOM) and ‘Go Blue’ is the unofficial university greeting (Figure 1). This was immediately after I completed my fellowship with UOM firmly etched in my mind.

Background: I was awarded a two-year Ministry of Health Research Scholarship in 2008 and was one of the earliest recipients of this award. My department decided that it would be best that I spend this period with Professor Kevin C Chung at the Section of Plastic Surgery, University of Michigan Health System, Ann Arbor (Figure 2). The majority of Professor Chung’s practice is Hand Surgery. He is also very well published and a world authority on Evidence-based-Medicine and Cost-Utility Studies. He is originally from Taiwan, did his primary schooling in Singapore before immigrating to the U.S.A. He has been associated with our department for quite some time having visited us as a Sterling Bunnell Fellow of the American Society for Surgery of the Hand. The Plastic Surgery Department at the University of Michigan is amongst the oldest in the USA and is one of the most sought after Plastic Surgery Residency Program. The founding fathers of this department included Drs Reed Dingman and William Grabb. Grabb’s textbook of Plastic Surgery and Flaps is still required reading for all plastic surgeons.

Early Days: I left for my fellowship in June 2009, a month after my exit examination and landed at Detroit, Michigan on June 27, 2009 with my 6-year-old son and 3-month pregnant wife. A friend of mine picked us up from the airport and drove us to Ann Arbor, which is a short 30 minute drive from the airport. I had already rented a house over the internet and we were able to settle in uneventfully over the next few days. We bought a used car, got all the utilities, and secured admission for our son in local public school.
I reported for work on 29 June 2009 and was introduced to the senior staff and Professor Chung’s research team. Professor Chung had made a detailed research and clinical program for me based on our previous discussions. My clinical goals included learning joint replacement arthroplasty for the rheumatoid and osteoarthritic hand, surgery for the spastic hand, and management of congenital hand differences. The research goals were to learn how to do a meta-analysis and systematic reviews, learn about cost utility studies, and improve my publication index. At Michigan, Hand Surgery is done by both Plastic and Orthopedic Surgeons with the Hand Surgery call roster shared between the two specialties. In addition to Professor Chung, Professor Kuzon and Associate Professor Haase from Plastic Surgery (Figure 3) and Associate Professor Lawton and Associate Professor Ozer from Orthopedic Surgery were predominantly doing Hand Surgery.

**Work schedule:** The ward rounds started at 6 A.M. I joined the residents on the ward rounds. There was usually no teaching during the rounds. Daily teaching session runs from 7.00 AM – 8.00 AM with breakfast provided. Depending on the day of the week, this was followed by operating room, outpatient clinic, or research session. Professor Chung had two days of operating room sessions, two days of outpatient clinics, and one day of research. On Monday evenings from 5:00 PM till 6:30 PM, we had the Hand Conference attended by all hand surgeons, orthopedic and plastic surgery residents and fellows. I was not part of the emergency call roster, but was called in for emergency cases that required microsurgery (replantation/ revascularisation).

**Clinical work:** Although I was there on a research scholarship, I was fortunate to be able to participate actively in surgery and patient care. I was able to assist Professor Chung and Associate Professor Haase in a wide variety of cases. In addition to surgery for the traumatic hand, I was exposed to a soft tissue reconstruction in rheumatoid arthritis, joint replacement arthroplasty for rheumatoid arthritis and osteoarthritis, and to a wide variety of congenital differences. My experience in trauma reconstruction gained at Singapore stood me in good stead during my fellowship. I was actively involved in the management of most major hand injuries (Figure 4) and flap reconstruction of the limb. I was a member of the faculty at the AO Course ran at the University of Michigan in September 2010. I also attended the 65th Annual Meeting of the American society for Surgery of the Hand held at Boston in September 2010.
Research: I was able to participate as a guest scholar in the Robert Wood Johnson Foundation Clinical Scholars Program for one semester (from July till September 2009). This introduced me to quantitative and qualitative research methods underlying health services research essential to improving health and medical care systems. Professor Chung has a very effective research team (Figure 5). I was able to write ten papers that have been published in peer reviewed international journals and 50 book chapters. These include two chapters in the Grabb’s textbook of Plastic surgery. I also had the opportunity to edit a textbook of hand surgery meant for the non-specialists. This is planned for release at the next meeting of the International Federation of Societies for Surgery of the Hand to be held at New Delhi in March 2013.

Friends and Fun: My co-fellows at Michigan included Dr Pao-Yuan Lin from Kaohsiung, Taiwan; Dr Shimpei Ono from Tokyo, Japan; and Dr Nathan Taylor from Marquette, Michigan. All three of them were great guys. I was lucky to be part of such a terrific group. Not only did I learn a lot from them, but I made some wonderful lifelong friends. The best part of the fellowship however was not being on-call. This allowed me to spend a lot of time with my family. We practically drove all around Michigan. We visited a number of places in the US and Canada. Our youngest son was born in the middle of a really cold Michigan winter and loved walking in the snow (Figure 6). My family really enjoyed the two years we spent at Michigan. Overall, I had a great fellowship experience…learnt a lot….published a lot….had lots of fun…. M Go Blue!

Figure 5. The Research Team (L to R) Melissa Shauver, Sandeep Sebastian, Kathy Chan, Pouya Entezami, Pao Yuan Lin, Nathan Taylor, and Shimpei Ono

Figure 6. Ishan snow walking at 14 months, Banff, British Columbia
REPORT BY CLINICAL FELLOWS
Spine Fellowship

Fellow : Dr Jereme Bacalso Atupan  
Supervisor : Professor Wong Hee Kit  
Period : July 2010 – January 2011

“I was able to encounter a variety of cases in the wards and outpatient clinics. There was an adequate level of clinical exposure.”

“Good supervisor. He emphasizes on the importance of good clinical examination and good surgical technique based on sound principles and makes sure that all fellows are equipped with these principles…would recommend this training programme to others.”

Fellow : Dr Ashwin Avadhani  
Supervisor : Associate Professor Hee Hwan Tak  
Period : October 2010 – April 2011

“I had the opportunity to work with five spine consultants on a variety of spine pathologies.”

“I assisted nearly 100 spine cases in my six-month stint.”

“An excellent supervisor. My supervisor is a very approachable teacher. He often discussed the management of cases with me and also provided me an opportunity to write a research paper. This active involvement ensured brisk progress of the research project.”

“My supervisor adequately supervised my clinical and surgical skills…would recommend this training programme to others.”

Fellow : Dr Vivek Kamalkishore Mittal  
Supervisor : Professor Wong Hee Kit  
Period : March 2011 – August 2011

“A good training programme…there was good exposure to various fields of spine surgery including deformities, degenerative conditions, tumours and minimally invasive surgery.”

“There was reasonably good patient load and exposure to operative surgery.”

“Good supervision…consultants supervise work of fellows at all levels…would recommend this training programme to others.”
Fellow : Dr De Vera Delfin Jr  
Supervisors : Associate Professor Hee Hwan Tak and Assistant Professor Gabriel Liu  
Period : March 2011 – June 2011

“Adequate exposure to clinical cases…introduced me to the latest and advanced techniques in spine surgery.”

“Excellent supervisors. My supervisors are very knowledgeable. They were adept to the latest innovations and techniques in spine surgery…would recommend this training programme to others.”

Adult Reconstruction Fellowship

Fellow : Dr Shivakumar Harluru Shankaraiah  
Supervisor : Professor Shamal Das De  
Period : November 2010 – May 2011

“There was excellent supervision and guidance from the supervisor.”

“It has a good teaching programme. There was good amount of clinical work and surgery.”

“Excellent supervisor. I had an opportunity to learn excellent clinical and surgical skills from him…would recommend this training programme to others.”
Sports Medicine Fellowship

Fellow : Dr Bea Kia Chuang  
Supervisors : Mr Andrew Dutton and Professor V P Kumar  
Period : November 2010 – May 2011

“There was an organized and systematically run fellowship programme…there were excellent supervisors and mentors…there were equal opportunities in learning knowledge and in acquiring hands-on skills.”

“There was a well-organised timetable for daily activities including operating theatre sessions, outpatient clinics, self study and research.”

“Excellent supervisors. My supervisors were knowledgeable and skillful clinicians and surgeons…they showed good examples on patient care and management…more importantly, they were willing and highly enthusiastic in teaching and sharing their experiences…would highly recommended this training programme to others.”

Musculoskeletal Oncology Fellowship

Fellow : Dr Kaki Ratnakar Rao  
Supervisor : Associate Professor S Suresh Nathan  
Period : December 2010 – June 2011

“Good training programme…there was a well-organised system.”

“There were opportunities to assist in complex cases.”

“Excellent supervisor. The supervisor was kind, knowledgeable and a good teacher with excellent skills.”

“The supervisor continuously monitored my work and gave good advice…would recommend this training programme to others.”
Paediatric Orthopaedics Fellowship

Fellow : Dr Ashwin Chowdhary  
Supervisor : Associate Professor James Hui  
Period : August 2010 – February 2011

“Good training programme. There was an adequate level of clinical exposure.”

“Good supervisor.”

“There was an adequate level of supervision…would recommend this training programme to others.”

Fellow : Dr Surbhit Rastogi  
Supervisor : Associate Professor James Hui  
Period : April 2011 – October 2011

“Excellent training programme.”

“My supervisor is an excellent clinician, academician and a very good teacher.”

“There was an adequate level of clinical exposure.”

“Excellent supervisor. My supervisor takes personal interest in the fellow and makes sure he learns. Monday morning teaching is excellent…would recommend this training programme to others.”

Orthopaedic Trauma Fellowship

Fellow : Dr Burgula Vaarun  
Supervisor : Dr Hitendra K Doshi  
Period : October 2010 – April 2011

“Good training programme with good clinical exposure to both inpatients and outpatients. Good teaching received during fellowship. There was an adequate level of supervision.”

“He was very nice in the approach to patient treatment…would recommend this training programme to others.”
Hand and Reconstructive Microsurgery Fellowship

Fellow : Dr Kask Kristo
Supervisor : Dr Tan Ter Chyan and Dr Peng Yeong Pin
Period  : June 2011 – August 2011

“Excellent training programme. The theoretical teaching, lectures and discussions were very useful. Exposure to everyday practical work is without limitations.”

“There was an adequate level of clinical exposure.”

“Good supervisors.”

“There was an adequate level of supervision…would recommend this training programme to others.”

Fellow : Dr Teh Kok Kheng
Supervisor : Dr Peng Yeong Pin
Period  : September 2010 – February 2011

“Excellent training programme…good facilities, nice working environment, good teaching sessions.”

“There was an adequate level of clinical exposure.”

“Excellent supervisor…very encouraging department, friendly environment and many positive criticism and teaching.”

“There was an adequate level of supervision. I went on daily rounds with supervisor, grand rounds and audit rounds. There was also easy access to consultants for advice…would recommend this training programme to others.”
Fellow : Dr Vineet Dabas  
Supervisor : Dr Alphonsus Chong  
Period : April 2011 – October 2011

“Good training programme. Good clinical exposure, busy clinics. Evidence-based medicine being followed giving excellent results. Excellent grooming of young surgeons. Warm working environment.”

“There was adequate time to see various procedures. Training is an ever-ongoing process, but this fellowship provides a good stepping stone.”

“There was an adequate level of clinical exposure.”

“Good supervisor. I was lucky to have a methodical supervisor, who pays attention to all deficits to provide a good learning environment. He provided encouragement from time to time.”

“There was an adequate level of supervision. The clinic and operations done by training staff are well supervised…would recommend this training programme to others.”

“The training programme is a good, well-planned programme, providing academic, clinical, experimental and working experience seldom met in one place.”
2012 marks a significant milestone in the history of the Department of Orthopaedic Surgery, National University of Singapore. We celebrate our 60th Anniversary in October 2012 in conjunction with the 35th Annual Scientific Meeting of the Singapore Orthopaedic Association. This year’s RWH Pho Lecture, VK Pillay Lecture and N Balachandran Professorship Lecture will be the highlight of the SOA Meeting held from 11-13 October at the Four Seasons Hotel. A Gala Dinner will be held on 10 October 2012 at Shangri-la Hotel to celebrate our 60th Anniversary. The three special guest lecturers invited to UOHC for the 60th Anniversary are:-

**RWH Pho Lecturer 2012:** Professor Franklin H Sim, M.D.  
Department of Orthopaedics  
Mayo Medical School  
Rochester, USA

**VK Pillay Lecturer 2012:** Professor Gary G. Poehling, M.D.  
Department of Orthopaedic Surgery  
CompRehab Plaza  
Winston-Salem, North Carolina, USA

**N. Balachandran Professor 2012:** Professor Kaye E Wilkins D.V.M,M.D.  
President’s Council  
Dielmann Chair in Pediatric Orthopedics  
Professor of Orthopedics and Pediatrics  
Department of Orthopedics  
San Antonio, Texas, USA

In addition, a special 60th Anniversary Teaching Programme consisting of workshops / lectures and case discussions has been arranged from 8-10 October in UOHC, NUHS. The programme is targeted for our post-graduate residents. The faculty includes our distinguished lecturers. Their lectures are:-

- Musculoskeletal Oncology Programme – Dr Franklin H. Sim
- Acetabular Reconstruction Workshop (Cadaveric) – Dr Franklin H. Sim
- Session on Tumour Discussion – Dr Franklin H. Sim
- Lecture on Examination Technique – Dr Gary G. Poehling
- Paediatric Trauma Workshop – Dr Kaye E. Wilkins
- Lecture on Paper Writing – Dr Kaye E. Wilkins
Launch of University Orthopaedics and Hand Journal

The department has taken the opportunity to launch our first issue of The University Orthopaedics and Hand Journal during the 60th Anniversary Celebrations Gala Dinner on 10 October 2012. This marks an important milestone in the history of UOHC. The journal provides an important avenue for tracking UOHC’s progress in the future. It will also serve as the official publication of the National University Healthcare System Postgraduate Residency Programme.

To celebrate the 60th Anniversary the inaugural issue of the journal is produced as a special commemorative issue. It will record our important history and serve as a tribute to the contributions made by our predecessors and colleagues. The journal will also publish the achievements of UOHC over the last 10 years. In addition to publishing the Special Awards and Research Awards received over the last 10 years, it will also publish the abstracts of the top 3 publications for each staff member of UOHC from 2001 to 2011.
Organising Committee
60th Anniversary Celebrations

Chairperson: Prof Wong Hee Kit
Programme: A/Prof James Hui
A/Prof Wilson Wang
Sponsorship: A/Prof Suresh Nathan
Mr Tan Teck Chong
Treasurer: Sharona Chang
Guest List: Janet Han
Sharona Chang
UOH Journal: A/Prof Aziz Nather
Low Siew Leng
Teo Siew Ling
Eunice Mok
Logistics / Publicity: Sharona Chang
Eunice Mok
Acknowledgement

The Editorial Committee would like to thank the following:

• Professor K Satkunanantham, Director of Medical Services, MOH
• Associate Professor Benjamin Ong, Chief Executive, NUHS
• Associate Professor Yeoh Khay Guan, Dean, Yong Loo Lin School of Medicine, NUS
• Associate Professor Aymeric Lim Yu Tang, Chairman, Medical Board, NUH

for their congratulatory messages to University Orthopaedics, Hand and Reconstructive Microsurgery Cluster (UOHC) in celebration of the Department’s 60th Anniversary and the successful launch of the Inaugural and 60th Anniversary Commemorative Issue of the University Orthopaedics and Hand Journal.

We would also like to thank Professor Wong Hee Kit for his vision in starting a journal for UOHC and for his invaluable guidance and continuous support in all our endeavours to do our best in writing this journal. This is the first to be produced by a cluster of NUHS.

With the start of our Postgraduate Residency Training Programme in 2010, an increasing number of residents are being employed by UOHC. There is therefore an increasing demand for a more structured and comprehensive training programme for residents in the areas of clinical service, teaching and research. The journal will provide an excellent vehicle to chart and document our research and training. By publishing abstracts of all research work done, work in progress by our residents and by documenting special and research awards received each year, the journal will serve to promote research in UOHC. This inaugural and commemorative issue therefore marks the start of a new era in research. We are confident that other clusters will follow and start their own journals.

Finally, the Editor would like to thank all members of the editorial committee for all their help in producing this journal. We would also like to thank all staff for their valuable contributions.

Associate Professor Aziz Nather

Editor UOHJ
Dr Barry Peter Pereira passed away on 20 July 2012 after a long illness. He is survived by his wife Geraldine and five children. Dr Pereira joined the department as a Research Assistant in 1988. He was awarded Master of Engineering degree in 1996 and Doctor of Philosophy in 2004. Subsequently, he was promoted to Research Fellow and appointed Chairman of the Department Safety Committee. He has contributed significantly to upper limb research and was an invaluable member of the pioneering research such as aesthetic prosthesis, microsurgery, osteosarcoma cell line, vascular bone graft and limb salvage. In basic research, he remained consistent with a dedicated and passionate interest in the physiology and biomechanics of muscle tissue. His primary focus on the healing process of muscles in relation to its mechanical environment had also resulted in the development of a novel multi-segment musculoskeletal model. He was well integrated into both the medical and engineering communities and provided mentorship to new and budding researchers. His commitment and dedication to the pursuance of academic knowledge has inspired many old and new generation of doctors. Dr Pereira has left a lasting legacy with his numerous publications and academic achievements in the field of bioengineering and upper limb orthopaedic surgery. On a personal note, he was a loving husband and father and will be dearly remembered by family and friends.
The University Orthopaedics and Hand Journal welcomes abstracts that contribute to orthopaedic knowledge. Contributions will include abstracts from award winning papers, published articles and work in progress from residents and medical students. Full articles from invited authors will also be published.

STRUCTURED ABSTRACT

When submitting your contribution, it is essential to follow the following instructions:

1) Contributions will be accepted in the form of a structured abstract.
2) Each abstract should not exceed one A4-sized page for a published article, a research award paper or work in progress.
3) The manuscript must be typed, with spacing of 1.15pt and at least one inch margin on both sides and bottom. On the first page, please provide the title of article, name(s) of author(s) and name of department and institution in which the work was done.
4) Please prepare the abstract using the following structured format:
   a. Objective
   b. Methodology
   c. Results
   d. Conclusion
5) For a letter to editor, a review article or a case report, the abstract need not be structured.

References need not be included.

FULL ARTICLE (upon invitation only)

The manuscript must be typed using similar instructions as in the abstract. This should include illustrations/figures, tables and references. The article should not exceed 7 A4-sized pages, including illustrations and tables.

Illustrations/Figures

All illustrations will be published in black and white. Please insert the illustration(s) in the appropriate section of the manuscript.

Legend

Supply a caption for each illustration. Use Arabic numerals to number the figures consecutively as they appear in the text.

Tables

Type each table and its title in the appropriate section of the manuscript. Use Arabic numerals to number the tables as they appear in the text.

References

Number the references consecutively in the order in which they are first mentioned in the text. Use the form of references and title of journals abbreviated according to the style used in Index Medicus. List all authors. Examples of correct forms of references are:
Journal


Corporate Author


Books

- Schneider FR. Orthopaedics in emergency care. The CV Mosby Co. St Louis. 1980
The University Department of Orthopaedic Surgery was set up on 1 April 1952 in the Singapore General Hospital with Professor J A P Cameron as Head of Department. In January 1961, Professor D R Gass assumed the Headship. The first research laboratory was built in 1964. In 1965, an Animal Experimental Surgery Laboratory and Biomechanics Laboratory was set up in "Harrower's Hall" SGH. Other laboratories included Histology, Motion Analysis and Cadaveric Research Laboratory. In June 1985, the Department moved into the newly built National University Hospital.

National University Hospital is combined with Yong Loo Lin School of Medicine, NUS in January 2008 to form the National University Health System. Under NUHS, Department of Orthopaedic Surgery is combined with Department of Hand and Reconstructive Microsurgery to become the University Orthopaedics, Hand & Reconstructive Microsurgery Cluster (UOHC).

UOHC provides tertiary subspecialty care with University Spine Centre and Divisions of Hip & Knee, Shoulder & Elbow, Sports Injury, Paediatric Orthopaedics, Musculoskeletal Trauma, Musculoskeletal Oncology and Foot & Ankle Surgery in addition to Hand Surgery by Department of Hand & Reconstructive Microsurgery. The cluster now provides good infrastructure and research facilities in 6 core areas: cell and tissue culture, histology, biomechanics, motion analysis, bone densitometry and X-ray. It is actively engaged in cutting edge translational research and has won several local and international research prizes.
Then...

Now...

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