*inter*Link

Linking the International Community of TERMIS

In This Issue of *inter*Link

Edited and Compiled by:

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Queensland University of Technology

Sarah Wilburn
TERMIS Administrator

Letter from the Editor

Dear Colleagues,

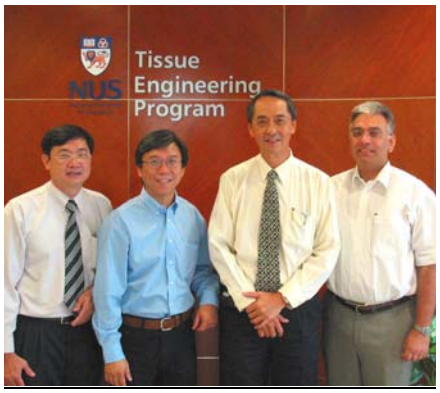
The 2nd TERMIS World Congress in Seoul was a great success and I am confident that our society for tissue engineering and regenerative medicine (TE/RM) will continue to blossom. It is evident that TE/RM sector clearly spans the global playing field with innovative research taking place across the U.S., Europe, and Asia. However, we need to be aware that technical innovations, legal positions, and regulatory challenges in one country or region can have a profound effect on the TE/RM industry worldwide.

In the absence of ethical, regulatory, and legal harmonization, it is unclear what the future holds for collaborations and commercialization strategies globally. Hence, our Society is the ideal organization to lobby with as Chris Mason & Peter Dunnill have recently published (Editorial in the journal *Regenerative Medicine* entitled "The need for a regen industry voice") one voice towards a plan to have one day such a harmonization across the globe.

Sincerely,
Dietmar W. Hutmacher

Laboratory Feature

NUS Tissue Engineering Program (NUSTEP)



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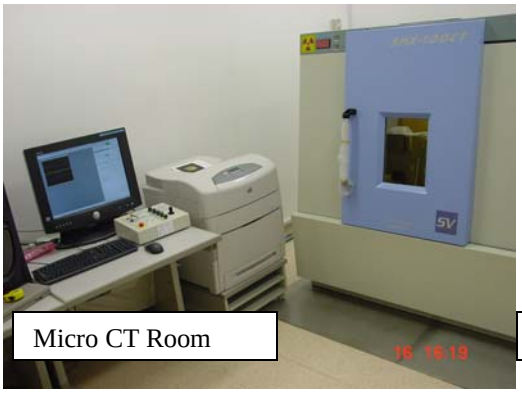
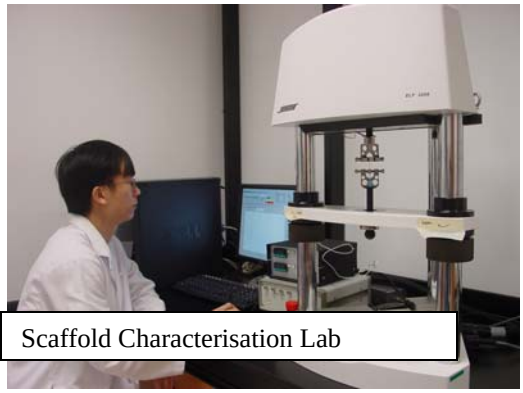
Left to Right: Prof SH Teoh, Prof James Goh (Program Leader), Prof EH Lee, Prof M Raghunath

The **NUS Tissue Engineering Program (NUSTEP)** is a multidisciplinary program in the Life Sciences Institute at the National University of Singapore. The program is under the leadership of Prof James Goh. It aims to develop core competencies and to create innovations in cell and construct technologies for effective integration of living systems for clinical therapies. The goal is to establish a globally competitive program in tissue engineering with significant research outcomes that will result in international recognition for high quality research with clinical and industrial applications. The facilities in NUSTEP include BSL2 Class 10K Clean rooms, Bio-imaging (micro CT and microscopy) Lab, Tissue Modulation Lab, Biomaterials and Scaffold Fabrication Lab, and Histology Lab as well as general labs for Principal Investigators and their teams. The program currently has ten PIs working in different aspects of tissue engineering.


Students Area


BSL2 Cell Culture Lab


Micro CT Room


Scaffold Characterisation Lab

Research Strategy

NUSTEP has developed a number of strategic technologies for tissues regeneration that are particularly crucial to musculoskeletal tissue engineering and regenerative medicine. We focus firstly on *Stem Cell Science;* this is to fully utilize the therapeutic potential of stem cells and its applications to tissue regeneration. Secondly, we focus on the development of biomimetic and functional scaffold as well as study the microenvironmental factors such as mechanical cues, bioactive factors and matrix properties in the regulation cell proliferation and differentiation. Thirdly, the development of suitable in-vivo models to evaluate tissue engineered devices. Finally, development of clinical trial for cell-based therapy and other tissue-engineered devices.

Research Focus

1. Stem Cell Science

In this focus area, we seek discoveries of new knowledge and greater understanding of adult and embryonic stem cells in regenerative medicine applications and the development of cell therapies for repair and regeneration of skeletal tissues.

Directed differentiation of stem cells (PI: Prof EH Lee, Prof Susan Lim)

One of our focus in the programme is on the differentiation of mesenchymal stem cells (MSC) towards chondrocytes to generate cartilage of different phenotype, ie hyaline cartilage of articular cartilage, fibrocartilage of meniscus or a zonal cartilage of resting, proliferative and hypertrophy cartilage of physeal cartilage. Fresh bone marrow collected from the consent patients in National University Hospital are isolated, expanded in number in culture and subsequently subjected to different manipulation including growth factor treatment, genetic force/knockdown manipulation (in collaboration with Genome Institute of Singapore). The influence of biomimetic microenvironment on the chondrogenesis of MSC is also being investigated and we have demonstrated that different biomimetic surface can dramatically alter the differentiation outcomes of MSCs [4]. Incorporation of this biomimetic surface on a 3D scaffold for the repair of critical size cartilage defect with MSC is currently being studied.

2. Biomimetic Scaffold Technologies

This group focuses on the design and development of novel biocompatible and biofunctional constructs for tissue engineering applications. Biofunctionalisation includes the use of regulatory biomolecules and control delivery systems.

2.1 PCL-TCP scaffold-based tissue engineering (PI: Prof SH Teoh)

The research focus is in the applications in load-bearing, hard tissues such as cartilage and bone. Our lab is currently further developing a rapid prototyping system for the fabrication of tissue engineering scaffolds with complex geometries. This was driven by the need for functionally and physiologically relevant scaffolds for the treatment of bone defects. At the same time, our lab is also developing novel material compositions based on a composite of biodegradable polymers such as polycaprolactone (PCL) and bone-like ceramics such as hydroxy apatite (HA) and tricalcium phosphate (TCP). Such polymer composites will improve the performance of bone scaffoldings by imparting greater mechanical stability and bio-functionality while maintaining bio-degradability. We have demonstrated the significant improvement of the scaffold's mechanical properties when TCP micro-particles were incorporated into PCL matrix. In vivo, we have shown enhanced bone regeneration using PCL-TCP scaffolds in a pig spinal fusion model. Biochemical improvements are also performed onto these scaffolds by modifying the scaffold's surface with biologically active molecules such as heparan sulfate and bone morphogenetic protein. These entities, in turn, are incorporated with the ultimate goal of assisting the integration of the implanted scaffold and bone repair outcome.

We are also exploring and developing biodegradable scaffolds fabricated using the electrospinning technique. Due to their unique physical properties, electrospun fibers and meshes have gained increasing interests in the tissue engineering field. However, due to nature of their fabrication, cellular and tissue integration into the scaffold's structure is often limited. We are currently developing a novel hybrid scaffold comprising of electrospun PCL-based fibers with hyaluronic acid hydrogel obtained via a modified electrospinning process. This hybrid scaffold has been shown to significantly improve the cellular integration and allow the controlled release of bioactive agents such as growth factors. Furthermore, we have also demonstrated the vascularization potential of these hybrid scaffolds.

2.2 Silk scaffold with weblike microporous silk sponges (PI: Prof SL Toh)

Cell seeding on knitted scaffolds often require a gel system, which was found to be practically unsuitable for anterior cruciate ligament (ACL) reconstruction as the cell-gel composite often gets dislodged from the scaffold in the in vivo dynamic situations. In order to overcome this problem, we fabricated a combined silk scaffold with weblike microporous silk sponges formed in the openings of a knitted silk scaffold (Fig 2A,B). Human MSCs adhered and grew well on the combined silk scaffolds (Fig 2C,D). Moreover, in comparison with the knitted silk scaffolds seeded with hMSCs in fibroin gel the cellular function was more actively exhibited on the combined silk scaffolds, as evident by real-time reverse transcriptase-polymerase chain reaction (RT-PCR) analysis for ligament-related gene markers, immunohistochemical (Fig 2H) and western blot evaluations of ligament-related extracellular matrix (e.g., type I, III collagen and tenascin-C, Fig 2E-G) components. While the knitted structure holds the microporous silk sponges together and provides the structural strength of the combined silk scaffold, the microporous structure of the silk sponges mimic the ECM which consequently promotes cell proliferation, function, and differentiation. This feature overcomes the limitation of knitted scaffold for ligament tissue engineering application [1].

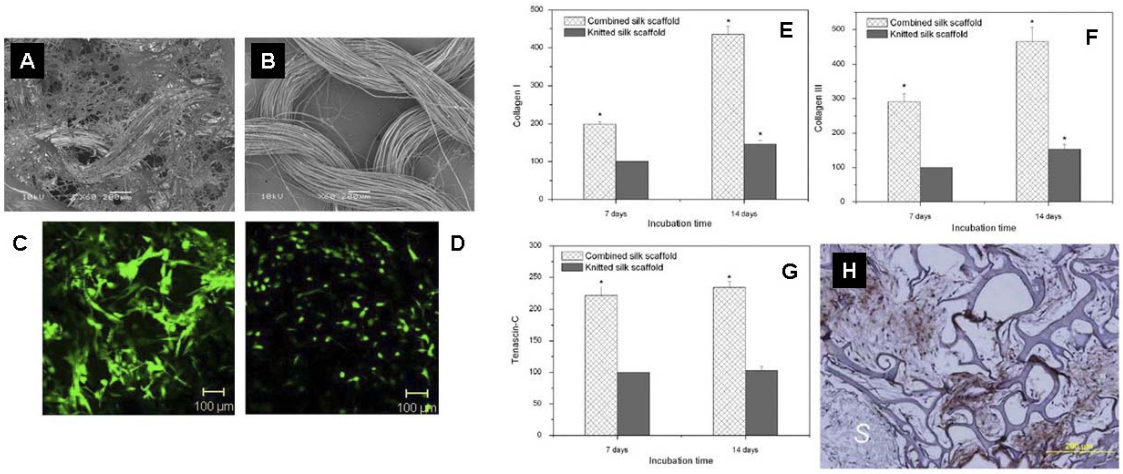


Fig. 2 Creation of a Silk scaffold with weblike microporous silk sponges for MSC-based ligament tissue engineering.

2.3 Tissue Modulation (PI: Prof M Raghunath)

The focus is to modulate the composition and stability of tissue by manipulating intrinsic or exogenous extracellular matrix (ECM), respectively. We aim to achieve this by modulating the phenotype of differentiated cells or human adult of human embryonic stem cells. Our expertise encompasses matrix and cell biology, biochemistry, molecular biology, clinical dermatology and industrial R&D experience. We pursue a two-pronged strategy, namely the development of enabling technologies for translational purposes, and characterizing their scientific basis:

a. Macromolecular Crowding (MMC)

We are currently rolling out a unique application platform for the use of MMC, a biophysical principle in nature that governs biochemical reactions in all biological systems. We champion the reverse bioengineering of crowded systems to create in vivo-like environments, not only for cell culture systems but also for cell-free settings, for example the polymerase chain reaction. In cell culture systems we have developed technology to induce fibrogenic cells to form more connective tissue, a crucial requirement for building coherent larger 3D blocks of tissue. Applying MMC we have been able to enhance matrix formation in vitro by at least one order of magnitude. We use the produced extracellular matrices as excellent substrates and niches for the maintenance of human embryonic stem cells and mesenchymal stem cells in an undifferentiated state. We have been able to produce a variety of human bioassembled extracellular matrices and are studying the ECM-stem cell interaction in terms of phenotypic modulation and induction of epigenetic changes.

b. Scar Wars

Fibrosis and scar formation result from an unwanted accumulation of collagen due to imbalance in production and degradation in repairing tissues. The effects range from cosmetic disfiguration to organ failure. Peri-implantation fibrosis represents a current road block in tissue engineering. We are interested to characterise novel antifibrotic drugs that tackle key events in the biosynthesis of collagen and its deposition into a matrix. To this end we have built a world-wide unique drug discovery tool, the Scar-in-a-Jar. The substances we are aiming to employ work at posttranslational and epigenetic level. Using a indication discovery approach, we are particularly interested candidate substances that have been approved already for other therapeutic uses. Interestingly, a group of substances, prolyl hydroxyase inhibitors, has not

only antifibrotic, but also a proangiogenic effects. As this would be an ideal combination we are developing currently biomaterials that deliver these substances locally into tissue, thereby providing vascularisation around the implant while keeping fibrosis at bay.

c. Biological Tissue Glue
Transglutaminases are enzymes that work as biological cross-linkers by forming isodipeptide bonds between target proteins (γ-glutamyl-Є-lysyl) in the extracellular space. As we have characterised the matrix-glueing properties of transglutaminase 2 in the past, we are taking this knowledge to the development of an enzymatic tissue glue for applications in eye surgery.

3. In vivo models to evaluate tissue-engineered devices

3.1 Anterior cruciate ligament regeneration using mesenchymal stem cells and silk scaffold (PI: Prof James Goh)

We studied the regeneration of anterior cruciate ligament (ACL) using MSC and silk scaffold first in rabbit [5] and followed up in a large animal model [6]. Microporous silk sponges/knitted silk mesh with autologous MSCs seeded was rolled around a braided silk cord to produce a tightly wound shaft that mimicked the structures of ligament extracellular matrix (ECM). Then the MSCs-seeded scaffold was implanted in pig model to regenerate ACL Fig 3A). At 24 weeks postoperatively, the MSCs in regenerated ligament exhibited fibroblast morphology. The key ligament-specific extracellular matrix components were produced prominently (Fig 3F) and indirect ligament-bone insertion with three zones (Fig 3B,C bone, Sharpey's fibers and ligament) was observed. Although there was remarkable scaffold degradation, we observed that the maximum tensile load of regenerated ligament could be maintained after 24 weeks of implantation. Our results imply that silk-based material has great potentials for clinical applications.

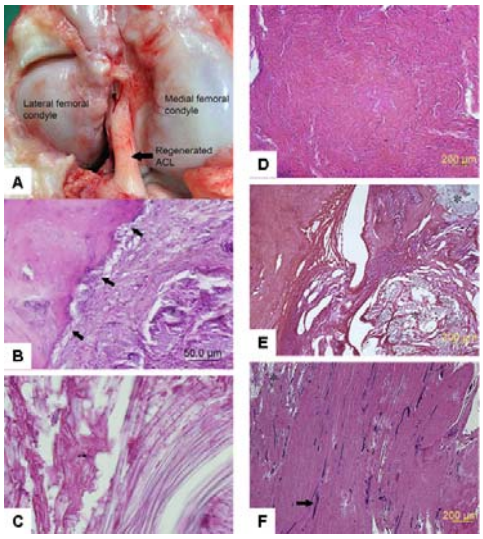


Fig 3 Macroscopic view of regenerated ACL in experiment group at 24 weeks postoperatively (A). Histological observation of regenerated ligament–bone junction in experimental (B) and control (C) groups at 24 weeks postoperatively. Histological observation of native ACL (D), regenerated ligaments in control group (E) and experiment group (F). Experiment group (MSCs/scaffold implantation, n= 6) and Control group (scaffold implantation, n= 6).

3.2 PCL-TCP scaffold as a bone graft substitute for bone regeneration in a procine model of interbody spine fusion (PI: Prof HK Wong)

Using the mPCL-TCP scaffold we developed, we evaluated bone ingrowth into in a large animal model of lumbar interbody fusion [7]. Six pigs underwent a 2-level (L3/4; L5/6) anterior lumbar interbody fusion (ALIF) implanted with mPCL-TCP + 0.6 mg rhBMP-2 as treatment group while four other pigs implanted with autogenous bone graft served as control. Computed tomographic scanning and histology revealed complete defect bridging in all (100%) specimen from the treatment group as early as 3 months. Histological evidence of continuing bone remodeling and maturation was observed at 6 months. This compare to the control group, in which only partial bridging was observed at 3 months and only 50% of segments in this group showed complete defect bridging at 6 months. Furthermore, 25% of segments in the control group showed evidence of graft fracture, resorption and pseudoarthrosis. In contrast, no evidence of graft fractures, pseudoarthrosis or foreign body reaction was observed in the treatment group. These results reveal that mPCL-TCP scaffolds could act as bone graft substitutes by providing a suitable environment for bone regeneration in a dynamic load bearing setting such as in a porcine model of interbody spine fusion.

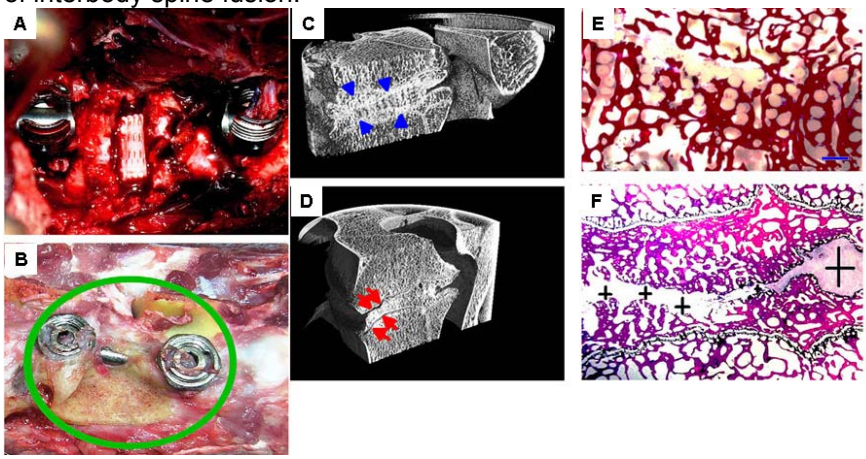


Fig 4 (A) showing a scaffold implanted into intervertebral disc space after decortication and screw fixation. (B) Harvested motion segment after 3 months implantation of mPCL–TCP scaffold + rhBMP-2 showing bone overgrowth covering part of the screw and rod fixation. Three dimensionally reconstructed □-CT images of scaffold + rhBMP-2 (C), and autograft bone (D) at 3 months post-surgery. Complete defect bridging was observed in the scaffold + rhBMP-2 group with smooth cage integration into host bone bed (blue arrow heads). This was absent among autograft bone implants with a thin line demarcating graft implant from the host bone bed evident at 3 months (red arrows). Histological evaluation showing: (E) areas of direct contact between bone tissue and scaffold strut filaments on sagital view at 3 months in the scaffold + rhBMP-2 group and (F) areas of extensive graft resorption resulting in pseudoarthrosis at 6 months in the autograft bone group (+).

3.3 Cartilage tissue engineering using a biphasic osteochondral implant with mesenchymal stem cells (PI: Prof James Hui)

This study was set up to evaluate a novel technique of cartilage tissue engineering using a biphasic osteochondral scaffold seeded with autologous MSC and a membrane in a large weight bearing porcine model. A dual phase construct comprising of a cartilage Polycaprolactone (PCL) scaffold and a Polycaprolactone-Tri Calcium Phosphate (PCL – TCP) osseous matrix. Autologous 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. We observed cartilage repair 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 ingrowth was enhanced in the experimental group. Healing was compromised in the absence of the implanted cells or resurfacing membrane. Our results indicate that MSC seeded biphasic implant coupled with an electrospun membrane assisted osteochondral healing.

3.4 Skin Tissue Engineering (PI: Prof TT Phan)

The research group concentrates in wound healing and keloid biology research. The group was the first in the world to explore the role of epidermal-dermal interactions in keloid pathogenesis. This claim has been recognized in publications in key biomedical journals, by local and international research awards and at presentations in numerous scientific meetings. More importantly, our results have been reproduced by different independent research groups in the USA, Canada and Japan, which has strengthen the role of epidermal-dermal interactions in keloid pathogenesis and indicate that keratinocyte-fibroblast co-culture is a useful system for keloid research and drug development. The group's novel model and significant research data have yielded significant interest from a number of local cancer biologists, who intend to apply this model in their own research on tumor-stromal interactions in carcinogenesis. Collaboration work is planned with them to push this research to a higher level. To date the group's tissue and skin cell culture database repository, which has been built up over the past few years is likely to be, at the current time, the most extensive in the world. This unique resource has been beneficial not only to our projects, but also to many other research groups in Singapore and overseas.

4. Clinical trial for cell-based therapy

Cartilage repair comparing the clinical outcome of patients treated with first generation autologous chondrocyte implantation (ACI) using chondrocytes versus bone marrow derived mesenchymal stem cells.

Following the MSC-based repair of cartilage defects in medium and large animal models [8,9], Prof James Hui and Prof EH Lee are currently conducting an ongoing prospective observational cohort study designed to investigate the effectiveness of chondrocytes and BMSCs as sources of cells for ACI, in repairing full-thickness cartilage defects of the knee. Conducted in our cGMP / cGTP facilities in NUHS, 72 matched (lesion site and age) patients underwent ACI using chondrocyte (n=36) or BMSC (n=36). Clinical outcome was measured pre-operation and 3, 6, 9, 12, 18, and 24 months post-operation using International Cartilage Repair Society (ICRS) Cartilage Injury Evaluation Package which included questions from the Short-Form (SF-36) Health Survey, International Knee Documentation Committee (IKDC) subjective knee evaluation, Lysholm knee scale, and Tegner activity level scale. We found a significant improvement in the patients' quality of life (physical and mental components of the SF-36 questionnaire included in the ICRS package) after implantation over time, with BMSC and Chondrocyte groups found to be equally effective. Greater improvement in "Physical Role Functioning" was reported by the BMSC group (P=0.044 for interaction effect). The improvement in clinical symptoms after cartilage repair using BMSCs in our clinical trial agrees with clinical outcomes of earlier studies in which clinical symptoms were reported to have improved and repair of cartilage detected.

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2009 Wake Forest Institute for Regenerative Medicine Young Investigator Awards

The Wake Forest Institute for Regenerative Medicine has awarded the Young Investigator Award for the second year. This award is designed to recognize outstanding achievements by members of the Tissue Engineering and Regenerative Medicine International Society (TERMIS) who is in the early stages of a career in regenerative medicine. The award consists of a certificate, a $2,500 cash prize and recognition at the 2009 TERMIS World Congress. We are pleased to announce this year's winners: Christopher J. Bettinger and Kara L. Spiller.

Christopher J. Bettinger studied at the Massachusetts Institute of Technology where he received an S.B. in Chemical Engineering in 2003, an M.Eng. in Biomedical Engineering in 2004, and a Ph.D. in Materials Science and Engineering in 2008. He completed his doctoral work under the supervision of Prof. Robert Langer where he worked to develop micro- and nanoscale biomaterial systems for use in tissue engineering. He is a currently a postdoctoral fellow working in the field of organic electronics under the supervision of Prof. Zhenan Bao in the Department of Chemical Engineering at Stanford University.

Kara L. Spiller completed her B.S./M.S. degrees at Drexel Univeristy in 2007. She has continued her thesis work as an NSF Fellow in the Biomaterials and Drug Delivery Lab at Drexel University in Philadelphia, under the advisement of Dr. Anthony Lowman. Her thesis project is entitled "Semi-degradable, multi-functional hydrogels for the repair of cartilage defects." Following TERMIS-WC, Ms. Spiller will continue on to the Shanghai Key Tissue Engineering Laboratory, under the advisement of Drs. Yilin Cao and Wei Liu, to complete the capstone project of her research as part of the National Science Foundation Doctoral Dissertation Enhancement Program.

North American Chapter

Committee Updates

The North American Chapter of TERMIS has recently established two committees to assist the North American Council. The two committees are: the External Affairs Committee that is chaired by Anthony Ratcliffe and the Industry Development Committee, chaired by Kiki B. Hellman.

External Affairs Committee

There has been an increasing interest in TERMIS-NA working with other societies and organizations, and in response to this the External Affairs Committee has been formed. The members of the committee are Anthony Ratcliffe (Chair, Synthasome, Inc), Robert Sah (UC San Diego) and Stephen Badylak (University of Pittsburgh). The objective is to stimulate and coordinate the interaction of TERMIS-NA and other societies and organizations with complimentary interests. It is anticipated that this active participation with other groups will increase the impact of TERMIS-NA, and enhance the technology and information exchange vital for the continued growth of the field.

Currently, two co-sponsored workshops with other societies have been agreed.

1. The American Society for Matrix Biology (ASMB) and TERMIS-NA will hold a joint session at the 2010 ASMB meeting to be held October 24 - 27 in Charleston, NC.

2. A joint meeting of the International Society for Stem Cell Research and the Society for Biological Engineering, to be held in Boston, May 2 5, 2010 will have a session co-sponsored with TERMIS-NA.

The committee will continue to consider and plan for other collaborative interactions. If TERMIS-NA members wish to propose new collaborative events, please contact one of the committee members, or Sarah Wilburn at swilburn@termis.org.

Industry Development Committee

Scientific and medical progress in tissue engineering and allied disciplines has given rise to novel therapeutic strategies for functional repair or replacement of human tissues and organs, often summarized as 'regenerative medicine.' However, to translate discovery research into medical practice and to support and sustain the many emerging and established companies working toward development of products, certain common challenges must be addressed. Those include: 1) rigorous experimental studies and definitive clinical trials; 2) processing and manufacturing controls and quality systems development; 3) licensing of intellectual property – a critical bridge to commercialization and subsequent patent protection; 4) regulatory evaluation and product approval from relevant authorities required for marketing products; 5) cost recovery and reimbursement; and 6) the positive perception of the different publics which provide funding for supporting the entire enterprise and, ultimately, market acceptance.

There is currently no entity that is addressing these challenges in a cohesive, focused manner and/or engaging the many diverse and varied constituencies. Since TERMIS-NA represents individuals and organizations from many different sectors, i.e., academe, institutes, industry, government, working toward the goals of advancing the science as well as developing therapies to meet clinical needs, it is proposed that a Committee on Industrial Development be established within the society to address the challenges and needs facing the industry. Given the scientific progress over the last several years, the time has come for such entity/group to aid the members in meeting these challenges and in building as well as representing the regenerative medical industry to the appropriate constituent communities.

The members of the Industry Development Committee are: Kiki B. Hellman (Chair, Hellman Group, LLC), Timothy Bertram (Tengion, Inc.), Peter C. Johnson (Scintellix, Inc.) and Bill Tawil (Baxter BioSurgery).

NIH Center for Scientific Review – Volunteer Reviewers

The National Institutes of Health (NIH) is looking for senior, experienced members of TERMIS, who are interested in becoming volunteer reviewers.

Anyone interested is to email Sarah Wilburn, swilburn@termis.org, as soon as possible with the following requested information including:

- Name (First and Last)
- Institution
- E-mail address
- Web address
- Area of expertise
- The most appropriate study section or Integrated Review Group, if known
- Recent funding sources

The NIH's criterion is straightforward. The NIH is seeking reviewers who:

- are experienced senior scientists,
- have received major peer-reviewed research support either from NIH or an equivalent agency,
- understand the grant review process, and
- are willing to serve as study section members.

Please email the requested information to Sarah Wilburn, swilburn@termis.org.

TERMIS Chapter Meetings

2010 Chapter Meetings

TERMIS-EU: Galway, Ireland
Conference Dates: 13-17 June, 2010
Meeting Chair: Prof. Abhay Pandit
Conference Venue: Galway Radisson SAS Hotel

TERMIS-AP: Sydney, Australia
Conference Dates: September 2010
Meeting Chair: A/Prof. Geoffrey McKellar

TERMIS-NA Orlando 2010
Conference Dates: December 5-8, 2010
Conference Location: the Hilton located at the Downtown Disney Resort
Conference Chair: Anthony Atala, MD
Scientific Chair: James Yoo, MD, PhD
Hosted by: Wake Forest Institute for Regenerative Medicine

2011 Chapter Meetings

TERMIS-EU 2011: Granada, Spain
Conference Dates: 7-10 June 2011
Conference Location: Granada Exhibition and Conference Centre
Conference Chair: Antonio Campos Muñoz, MD, PhD
To request further information, please send an email to acampos@ugr.es.

TERMIS-NA 2011: Houston, Texas
Conference Dates: Fall 2011
Conference Chairs: Antonios Mikos, PhD and Jennifer West, PhD
Hosted by: Rice University

TERMIS-AP 2011: Singapore
More Information Coming Soon

MARK YOUR CALENDARS!

2012 3rd TERMIS World Congress

In

Vienna, Austria

September 5-8, 2012

Hofburg Congress Center

"Tissue Engineering and Regenerative Medicine"
Conference Chair: Heinz Redl, PhD
Program Chair: Martijn van Griensven

Ludwig Boltzmann Institute for Trauma Care in the AUVA Research Center and
the Austrian Cluster for Tissue Regeneration
Expertissues – NoE
TERMIS

To request further information, please send an email to **Office@lbitrauma.org**.

Upcoming Conferences Endorsed by TERMIS

Please save the date: The **6th Symposium on "Biologic Scaffolds for Regenerative Medicine"**. The symposium will be held on April 25 – 27, 2010 at the Silverado Resort in Napa Valley, California.

ORGANIZER/CHAIRPERSON: Stephen F. Badylak, DVM, PhD, MD –University of Pittsburgh

CALL FOR ABSTRACTS and SYMPOSIUM TOPICS: Abstracts will be considered for all topics related to the use of biologic scaffolds for tissue engineering/regenerative medicine including: fundamental concepts of cell-scaffold interactions, tissue source and processing/manufacturing methods, pre-clinical in-vivo studies of tissue and organ reconstruction, factors that influence the host remodeling response, and results/outcomes of human clinical applications. It is anticipated that approximately 50% of the abstracts accepted for podium presentation will relate to human clinical experiences in body systems that include cardiovascular, gastrointestinal, urologic, dermatologic, musculoskeletal, and the central nervous system. Abstracts will be considered for podium presentation and poster session display.

Deadline for receipt of abstracts is November 15th, 2009. Notification of abstract decision will be December 15th, 2009.

Web Address:
www.mirm.pitt.edu/events/2010_Meetings/scaffoldssymposium.asp

INVITED SPEAKERS INCLUDE:

Martin Birchall, MD
BristolUniversity

DavidMcQuillan,PhD
LifeCellCorporation

DinakarGolla,MD,FACS
UniversityofPittsburghMedicalCenter

BuddyRatner,PhD
UniversityofWashington

JoeIannotti,MD,PhD
ClevelandClinic

GordanaVunjak-Novakovic,PhD
ColumbiaUniversity

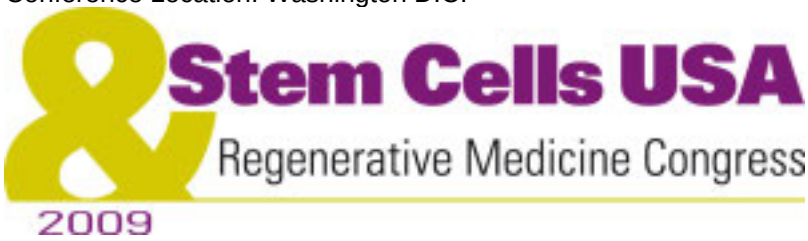
Early Registration Fee…….thru January 10th2010……...Student rate $250…….TERMIS rate $325…….Full rate $375

Registration Fee……..Student rate $250…….TERMIS rate $400…….Full rate $450

On-site Registration Fee…....after April 1st2010…….. Student rate $350…….TERMIS rate $500…….Full rate $550

November 2009

- Stem Cells USA & Regenerative Medicine Congress
  Conference Dates: 17-19 November 2009
  Conference Location: Washington D.C.



- Combined Meeting of the ESGCT, GSZ, DG-GT and ISCT
  Conference Dates: 20 - 25 November 2009
  Conference Location: Hannover, Germany
  Deadline for abstract submissions: 15 August 2009
  Registration opens: 18 April 2009
  2nd Announcment

January 2010

- Stem Cells World Congress
  Conference Dates: 20-21 January 2010
  Conference Location: San Francisco, California

February 2010

- Meniscus 2010
  The Meniscus: From Cradle to Rocker
  Conference Dates: February 4-6, 2010
  Conference Location: Ghent, Belgium
  Conference Chairs: R. Verdonk and P. Beaufils

March 2010

- 14th Annual Hilton Head Workshop
  Regenerative Medicine: Advancing to Next Generation Therapies
  Workshop Dates: March 7-10, 2010
  Hilton Head, South Carolina
  Abstract deadline: November 13, 2009

April 2010

- Translational Regenerative Medicine Forum
  Forum Dates: April 6-8, 2010
  Forum Location: Twin City Quarter, Winston-Salem, N.C.

- 6th Symposium on "Biologic Scaffolds for Regenerative Medicine"
  Symposium Dates: April 25-27, 2010
  Organizer/Chair: Stephen Badylak, DVM, PhD, MD
  Symposium Location: The Silverado Resort, Napa Valley, California
  Deadline for Abstract Submission: November 15, 2009

June 2010

- TERMIS-EU: Galway, Ireland
  Conference Dates: 13-17 June, 2010
  Meeting Chair: Prof. Abhay Pandit
  Conference Venue: Galway Radisson SAS Hotel
  Closing Date for Symposia Submissions: 15th September 2009
  Open Call for Abstracts: 15th October 2009

September 2010

- BIOSPINE 3 - 3rd World Congress on Biotechnologies for Spinal Surgery
  Conference Dates: September 1-4, 2010
  Conference Location: Amsterdam, The

Netherlands

BIOSPINE 3

3rd International Congress Biotechnologies for Spinal Surgery

Amsterdam, The Netherlands
September 1st–4th, 2010

- TERMIS-AP: Sydney, Australia
  Conference Dates: 15-17 September 2010
  Conference Location: Sheraton on the Park, Sydney
  Meeting Chair: A/Prof. Geoffrey McKellar

October 2010

- ASMB 2010 Biennial Meeting
  Conference Dates: October 24-27, 2010
  Conference Location: Marion Hotel, Charleston, SC
  Organizer: Jean Schwarzbauer, Princeton University
  Keynote: Elaine Fuchs, Rockefeller University

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