

Compiled and Edited by  
Felicity Rose (UoN) & Vivek Mudera (UCL)

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## President's Statement

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***Our TCES meeting this year*** at Queen Mary College was successful with a high representation of early stage researchers. The Queen Mary group should be congratulated at running an excellent meeting.

At the AGM, we agreed to establish a Young Investigator Award Scheme. The scheme will be held annually and will include an oral presentation from the winner at our meeting. Nominations will be sought in January 2006 to be decided by the committee for award in Summer 2006 at the Sheffield meeting. We hope

this will give us an opportunity to encourage and applaud our new investigators in the field within the Society. There will also be a cash prize to support the winner.

The Society is working with the European Society in establishing links with an International Tissue Engineering Society (TESI). The next meetings of these Societies are in Munich (ETES) and Shanghai (TESI) respectively - details available later on in this newsletter.

The Committee welcomed our new members, postgraduate (Sayed-Hadi Mirmalek-Sani) and postdoctoral representatives (Stephen Curran) onto the committee. Read on to hear from Hadi and Steve. In addition, it was decided that the newsletter will remain freely available to all those interested in the field of Tissue Engineering. We hope you continue to enjoy reading our newsletter!

Alicia El Haj  
Chairman TCES Society

## From the editors

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***If you wish to contribute*** to the TCES newsletter (next edition out Winter 2005) then please email us at....

[f.rose@nottingham.ac.uk](mailto:f.rose@nottingham.ac.uk) (Felicity Rose) or  
[v.mudera@ucl.ac.uk](mailto:v.mudera@ucl.ac.uk) (Vivek Mudera).

We are particularly interested in receiving research articles from young researchers so if you have presented your research at a conference recently and would like to write it up as a newsletter feature, please contact us.

We look forward to hearing from you!

## Tissue Engineering Mission to India, China and Japan

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### ***Mission funded by EPSRC INTERACT.***

This mission was led by Dr Vivek Mudera UCL with Professor Robert Brown (Director TREC UCL) and Miss Sally Brown (administrator BRITENET) as accompanying members. The main objectives of the mission were to explore and develop new collaborations with scientists, engineers and industry involved in Tissue Engineering (TE) in these countries. Another goal was to explore the extent and nature of funding in this area, the amount of industrial funding, and avenues for commercialisation of technology developed.

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### Japan

#### ***Key research and sources of funding***

at the Universities were government grants, however at Tokyo University TE activity is funded by industry with four streams of separate funding from four different commercial bodies identified with the companies having first option on IP and commercialisation of research findings. Examples of research include Prof. Ung-il Chung who is involved in a commercially funded programme on using genetically modified dermal fibroblasts to grow bone. A major programme on Nano bioengineering lead by Prof Kazunori Katoaka has been established at the University of Tokyo. Tejin Laboratories is a subsidiary of a major industrial company investing in TE activities with a seed research laboratory and staff primarily interested in developing scaffolds. Tokyo Women's University also have a major TE initiative based around cell sheet engineering with recent clinical success using oral buccal mucosal cells grown as

sheets on a patented polymer and transplanted successfully onto the cornea. They also have an initiative on cardiac muscle sheet engineering using the nude mouse as an *in vivo* test model. Kyoto University has a government funded research initiative in head and neck TE with facilities for *in vivo* testing using a variety of *in vivo* models (dog, cat, chinchilla, primate, rabbit, rat and mice) using cell seeded commercial collagen based substrates moulded to replace larynx and inner ear mastoid cells.

#### ***Key Contacts:***

Prof. Kanemaru (Kyoto University)  
[kanemaru@ent.kuhp.kyoto-u.ac.jp](mailto:kanemaru@ent.kuhp.kyoto-u.ac.jp)

Professor Ung-il Chung (Tokyo University)  
[uichung-ky@umin.ac.jp](mailto:uichung-ky@umin.ac.jp)

Professor Teruo Okano (Tokyo Women's University) [tokano@abmes.twmu.ac.jp](mailto:tokano@abmes.twmu.ac.jp)

Dr Yoshi Sumi, Teijin Co. [y.sumi@teijin.co.jp](mailto:y.sumi@teijin.co.jp)

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### India

***The key areas identified in India*** were the use of cell-based therapies, especially bone marrow derived stem cells in clinical trials. The Indian Council of Medical Research is a major research funding agency in India but as a policy there was no initiative to fund any major TE projects. It has however been identified as a key strategic activity to be developed and funded in the next 10 years. The Centre for Cellular and Molecular Biology, Hyderabad, has government-funded activity on TE bone, cartilage and muscle. TE activity does not have any commercial viability as an immediate outcome and is therefore entirely government funded. There are no evident immediate plans in India to move from cell based therapies to 3D structures due to lack of funding.

**Key Contacts:**

Dr. Vasantha Muthuswamy, Indian Council of Medical Research New Delhi 110 029: INDIA, Telefax: +91 11 26589791.

Dr. K. VijayRaghavan. National Centre for Biological Sciences. [vijay@ncbs.res.in](mailto:vijay@ncbs.res.in)

Dr. Jayashree Sengupta, Indian Council of Medical Research.

[jayasreesengupta@hotmail.com](mailto:jayasreesengupta@hotmail.com)

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**China**

**The Tissue Engineering and Regeneration Centre (TERC)**, Beijing is government funded and focussed on developing substrates (mainly chitosan based) for a host of TE applications including bone, cartilage, skeletal muscle, bladder, cardiac muscle, uterus, islet cell transplantation and also research on effects of microgravity on tissues using rotatory bioreactors. Shanghai has a major TE initiative headed by Professor Cao. This initiative is funded through a combination of government funding and venture capitalists. They have a 10 storied hospital under construction for Plastic and Reconstructive surgery and a dedicated set of theatres for aesthetic surgery. This commercial activity is intended to raise capital to fund TE activities. With a total staff of 80 surgeons and scientists they have GMP laboratory facilities for human cell based therapies. They have major initiatives in bone, tendon, skeletal muscle, cardiac and cartilage engineering using mainly PGA and PLA scaffolds. They also have dedicated facilities with *in vivo* models ranging from pig, rabbit, chicken, rat, mice, to facilities for generating genetically modified models. This group was the one identified with ability to use TE skeletal tissue in clinical trials. They have a few clinical trials on cartilage, tendon and bone in progress. They also

host this year's annual TESI (Tissue Engineering Society International) meeting in October and are keen to promote international collaboration. Their key sources of funding are from the Government, commercial and from venture capitalist.

**Key Contacts:**

Professor Yilin Cao MD, PhD. Shanghai Plastic & Reconstructive Surgery Hospital.

[yilincao@yahoo.com](mailto:yilincao@yahoo.com)

Professor Wei Liu MD, PhD. Shanghai Plastic & Reconstructive Surgery Hospital.

[liuwei\\_2000@yahoo.com](mailto:liuwei_2000@yahoo.com)

Prof Wang Chang Yong. Head of TERC, Beijing. [wcy2000@yahoo.com](mailto:wcy2000@yahoo.com)

Prof Guo Xi-min. Associate Professor, Tissue Engineering Research Centre. TERC, Beijing.

[guoxim@yahoo.com](mailto:guoxim@yahoo.com)

Vivek Mudera  
TREC (Tissue Repair & Engineering Centre)  
UCL Stanmore

## Research Article: Bridging the gap for neural repair

***In peripheral nerve damage***, the nerve distal to injury degenerates, leaving behind a loose connective tissue outer layer. Any skeletal muscle the injured nerve supplies also undergoes atrophy and therefore it is critical to innervate this muscle to prevent this. While it is easy to suture together two ends of nerve where a gap is <5mm, for longer gaps, conduits or autologous nerve grafts are used to plug the lesion. This is undesirable as the donor site is left compromised in terms of both motor and sensory function.

We have developed a form of nerve regeneration conduit based on high density, plastic-compressed collagen/fibronectin, as the basis of next generation biomimetic constructs. Plastic compression (PC) is a novel method for the development of highly biomimetic materials. This method has been principally used for collagen materials. The PC fabrication process is cell independent. The matrix is compacted by over 2 orders of magnitude by compression and deformation. The PC process significantly increases collagen density in these materials and significantly increases mechanical strength, allowing for PC constructs to be sutured *in vivo*. We have developed two types of nerve conduit, one which is a PC collagen sheet rolled to form a spiral structure (Fig 1), and one which mimics normal nerve structure i.e. with a connective outer layer and an inner conductive core designed to promote neural core regeneration (Fig 2). These components have been spiralled together to give gradual transition from one component to the other.

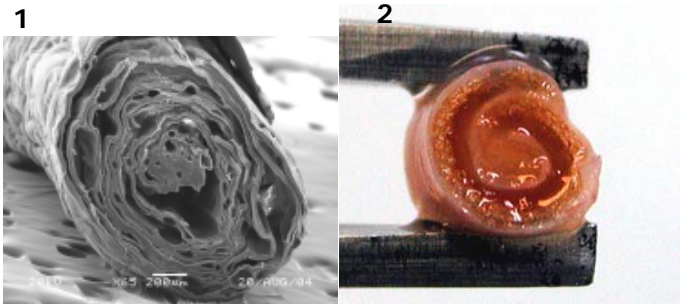


Figure 1: PC collagen spiral sheet rolled and Figure 2: PC collagen spiral sheet that mimics normal nerve structure.

Nerve regeneration constructs fabricated by PC of collagen and fibronectin were made rapidly, were robust and simple to suture into place, and easy to prepare with meso-structure built in. These included heterogeneous layers, zones and channels. The 50  $\mu\text{m}$  PC sheets have four key characteristics: (i) they are strong enough to take sutures when stitched, (ii) they are biomimetic, with native collagen layering and high collagen fibril density (iii) there is high cell viability during the PC process, with up to 90% cell survival, (iv) the process takes a few minutes and produces tissue-like constructs with 3D meso-scale.

Umber Cheema and Robert Brown  
Institute of Orthopaedics  
University College London

We are grateful to our collaborators in Rotterdam, Prof. Han Van Neck and Dr. Mischa Zuidendorp, and the BBSRC and EPSRC for funding.

### Reference

Ultra-Rapid Engineering Of Biomimetic Materials And Tissues: Fabrication of Nano-Micro Structures by Plastic Compression.' Brown, R.A. Wiseman, M. Chuo, C.B. Cheema, U. Nazhat, S. N. *Adv. Func. Mat. In Press*

## TCES Postdoctoral and Postgraduate Representatives

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*The tissue engineering community* has been growing rapidly over the last five years and this has been reflected in the rising number of national and international meetings, the increasing participation at these meetings, and the amount of funding dedicated to develop tissue regeneration strategies. In the UK, the TCES remains to be the largest society dedicated to advancing research in the field. The TCES is keen to support and hear ideas from younger researchers and has recently appointed postgraduate and postdoctoral representatives to the committee.

**Steve Curran** is the new postdoctoral representative for the TCES. Based at the University of Liverpool, Steve is chairman of the Science Integration Group and serves on the Steering Committee for the UK Centre for Tissue Engineering. His research interests are in bioreactor and bioprocess development for tissue engineering products and applications.

**Sayed-Hadi Mirmalek-Sani** is the TCES postgraduate representative. He is currently a 2nd year PhD student studying foetal & adult mesenchymal stem cell differentiation as well as bone regeneration within the Bone & Joint Research Group, University of Southampton.

Both Steve and Hadi are keen to hear from postdoctoral and postgraduate TCES members and other researchers associated with postgraduate work to help build a better framework of the postdoctoral and postgraduate tissue and cell engineering research within the UK.

In the first instance they are planning on introducing an email forum through which specific questions, news and discussion can be channelled in all areas related to tissue engineering. Through this medium they are hopeful that useful links will be established and collectively, they can develop a pool of expert knowledge that can be accessed freely. To begin this process they would like to ask that any TCES members, and others interested, email either Steve or Hadi so that they can generate a database of addresses and associated expertise to start the forum. Also please do contact any colleagues or friends who might be interested or be able to contribute, particularly in areas not directly associated with tissue engineering.

Do keep an eye on the TCES website over the next few weeks as the new forum will be implemented shortly for continued discussion and collaboration within this exciting field. This is your opportunity to express your opinions and have your views aired within TCES!

Steve Curran, University of Liverpool and Sayed-Hadi Mirmalek-Sani, University of Southampton

*Email addresses available at the end of this newsletter.*



## TCES Conference at Queen Mary, London June 2005

*The TCES summer meeting* was held on the 20th and 21st June 2005 in the Drapers lecture theatre at Queen Mary, University of London. Over 150 delegates attended the conference, both from leading UK institutions and from research groups worldwide. After opening remarks from David Lee the first session was opened by the keynote speaker Andrew Lloyd who presented work on cell/biomaterial interactions. This was followed by speakers including Paul De Bank, Holly Shearer, Abhay Andar and Lucia Csaderova who presented work on biomolecular engineering, PLGA, fluorescent monolayers and microfabricated surface rigidity patterns. The late afternoon session was opened by the keynote speaker Jim McWhir who talked about the use of human embryonic stem cells for bone repair. The session also included talks by Judith Curran, Jodie Pound and Nesta Hughes who presented work on silane modified surfaces, bioreactor culture of cartilage and differentiation of mesenchymal stem cells. The conference dinner was held in the Great Hall at St Bartholomew's Hospital and those who were brave enough could dance the night away to music provided by a live Latin American band. On the second day the morning presentations were opened by the keynote lecturer Irene Leigh who gave an overview of her work in skin tissue engineering. This was followed by speakers including Anthony Metcalfe, Sarah Grubb, Lisa Shuttleworth, Ali Soueid and Maritie Grellier who presented on the general subject areas of regeneration mechanisms, anti-inflammatory peptides, elastic fibres, pulmonary smooth muscle cells and vascular tissue engineering. After coffee the keynote speaker Matts Brittberg

presented work on cartilage repair systems, Rahul Tare on cartilage regeneration, Martin Knight (submitted by Belinda Pinguan) on chondrocyte calcium signalling, Theoni Katopodi on osteoarthritic chondrocytes, Mieke Heyde on a non-viral gene delivery system and David Green (submitted by Kris Partridge) on gene delivery. After lunch posters were judged by Alicia El Haj, Stephen Curran, Vivek Mudera and Matt Dalby. First prize went to Gellynck *et al.*, second prize to Buckley *et al.* and third prize to Wood *et al.* (see pictures). The final session was opened with a keynote lecture by Cees Oomens who presented work in the field of computational modelling. This was followed by speakers including Stephen Curran, Ben MacArthur and Karen Hampson who presented work on cartilage tissue engineering, heterogeneous cell populations and stem cell growth on PLA scaffolds. Overall the summer TCES meeting provided a thoroughly enjoyable and interesting two days.



TCES Poster Prizes awarded to Gemma Buckley (2nd prize, left) and to Mairead Wood (3rd prize, right). Prizes awarded by Professor David Lee.

Sophie Buck  
Tissue Engineering Group  
University of Nottingham

## TCES Conference July 2006

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**3rd and 4th July 2006**  
**University of Sheffield, UK**

Details of registration will be available on our website next year:

[www.tces.org](http://www.tces.org)

## Forthcoming Meetings

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### Tissue Models for Therapeutics

University Park Hotel@MIT, Cambridge  
Massachusetts, USA  
29th – 30th August 2005

[www.healthtech.com](http://www.healthtech.com)

### European Tissue Engineering Society (ETES)

Ludwig-Maximilians-University, Munich,  
Germany  
31st August – 3rd September 2005

[www.etes2005.org](http://www.etes2005.org)

### EuroNanoForum2005: Nanotechnology and the Health of the EU Citizen in 2020 (UK)

Edinburgh Exhibition and Conference  
Centre, Scotland, UK  
6-9th September 2005

[www.euronanoforum2005.org](http://www.euronanoforum2005.org)

### The UK Cord Blood and Adult Stem Cell Group Meeting

The Life Bioscience Centre, Newcastle, UK  
9th September 2005

[www.euroscicon.com](http://www.euroscicon.com)

### European Society for Biomaterials

University of Naples Federico II, Sorrento,  
Italy  
11th – 15th September 2005

[www.esb2005.it](http://www.esb2005.it)

### A Forecast of the Future of Biomaterials - Professor Larry L. Hench Retirement Symposium (UK)

Imperial College London  
29-30th September 2005

[www.imperial.ac.uk/materials/newsandevents/henchsymposium](http://www.imperial.ac.uk/materials/newsandevents/henchsymposium)

### Tissue Engineering Society International (TESI)

Shanghai, P.R. China  
22nd – 25th October 2005

[www.rmte.org](http://www.rmte.org)

### The Current Landscape in Regenerative Medicine

Birkbeck College, London, UK  
4th November 2005

[www.euroscicon.com](http://www.euroscicon.com)

**Forthcoming Meetings cont...**

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**First International Conference on  
Mechanics of Biomaterials & Tissues  
(USA)**

Hawaii, USA  
11-14th December 2005

[www.icmobt.elsevier.com](http://www.icmobt.elsevier.com)

**International Conference on  
BioMedical Engineering**

Suntec Singapore International Convention  
and Exhibition Centre, Singapore

7-10th December 2005

[www.iee.org](http://www.iee.org)



**TCES Board**

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**President**

Professor Alicia El Haj  
Centre for Science & Technology in  
Medicine  
University of Keele

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Medical Engineering Division and IRC in  
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Queen Mary, University of London

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Connective Tissue Research Group  
University of Cardiff

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TREC (Tissue Repair & Engineering  
Centre)  
UCL Stanmore  
(*Co-editor of TCES newsletter*)

**Board Member**

Dr Matt Dalby  
Centre for Cell Engineering  
University of Glasgow  
(*Website design and maintenance*)

**Board Member**

Dr Felicity Rose  
Tissue Engineering Group  
University of Nottingham  
(*Co-editor of TCES newsletter*)

**Board Member**

Stephen Curran  
UK Centre for Tissue Engineering  
University of Liverpool  
(*Postdoctoral Representative*)

**Board Member**

Sayed-Hadi Mirmalek-Sani  
University Orthopaedics  
University of Southampton  
(*Postgraduate Representative*)

# Non-student membership

## STANDING ORDER MANDATE

To Barclays Bank Plc \_\_\_\_\_

Branch \_\_\_\_\_

PLEASE TICK RELEVANT BOX:-

NEW INSTRUCTION

PLEASE AMEND PREVIOUS STANDING ORDER  
QUOTING REFERENCE/BENEFICIARY

### ACCOUNT TO BE DEBITED

### BENEFICIARY DETAILS

SORT CODE

BANK

Barclays

ACCOUNT NUMBER

BRANCH DETAILS

121 Queens St. Cardiff CF1 1SG

ACCOUNT NAME

SORT CODE

2 0 1 8 1 7

ACCOUNT NUMBER

9 0 6 6 0 7 2 8

BENEFICIARY NAME

TCES

REFERENCE

### PAYMENT DETAILS

AMOUNT OF FIRST PAYMENT

£

20.00

DATE OF FIRST PAYMENT

01 01 05

AMOUNT OF USUAL PAYMENT

£

20.00

AMOUNT OF USUAL PAYMENT IN WORDS

Twenty pounds and zero pence

WHEN PAID

(WEEKLY, MONTHLY, ANNUALLY, ETC)

Annually

DATE OF USUAL PAYMENT

01 01 05

COMPLETE EITHER  
AMOUNT OF LAST PAYMENT

£

AND DATE OF LAST PAYMENT

OR PLEASE CONTINUE PAYMENTS UNTIL FURTHER NOTICE  YES

CUSTOMER SIGNATURE(S)

DATE

CUSTOMER CONTACT TELEPHONE NUMBER

**ALL WHITE BOXES MUST BE COMPLETED  
IN ORDER FOR THE STANDING ORDER TO BE PROCESSED**

273 (02/02)

# Student membership

## STANDING ORDER MANDATE

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QUOTING REFERENCE/BENEFICIARY

ACCOUNT TO BE DEBITED		BENEFICIARY DETAILS	
SORT CODE	<input type="text"/>	BANK	<input type="text" value="Barclays"/>
ACCOUNT NUMBER	<input type="text"/>	BRANCH DETAILS	<input type="text" value="121 Queens St. Cardiff CF1 1SG"/>
ACCOUNT NAME	<input type="text"/>	SORT CODE	<input type="text" value="2 0 1 8 1 7"/>
		ACCOUNT NUMBER	<input type="text" value="9 0 6 6 0 7 2 8"/>
		BENEFICIARY NAME	<input type="text" value="TCES"/>
		REFERENCE	<input type="text"/>

PAYMENT DETAILS			
AMOUNT OF FIRST PAYMENT	£ <input type="text" value="10.00"/>	DATE OF FIRST PAYMENT	<input type="text" value="01"/> <input type="text" value="01"/> <input type="text" value="05"/>
AMOUNT OF USUAL PAYMENT	£ <input type="text" value="10.00"/>		
AMOUNT OF USUAL PAYMENT IN WORDS	<input type="text" value="Ten pounds and zero pence"/>		
WHEN PAID (WEEKLY, MONTHLY, ANNUALLY, ETC)	<input type="text" value="Annually"/>	DATE OF USUAL PAYMENT	<input type="text" value="01"/> <input type="text" value="01"/> <input type="text" value="05"/>
COMPLETE EITHER AMOUNT OF LAST PAYMENT	£ <input type="text"/>	AND DATE OF LAST PAYMENT	<input type="text"/> <input type="text"/> <input type="text"/>
OR PLEASE CONTINUE PAYMENTS UNTIL FURTHER NOTICE <input type="checkbox"/> YES			

CUSTOMER SIGNATURE(S)	<input type="text"/>	DATE	<input type="text"/> <input type="text"/> <input type="text"/>
CUSTOMER CONTACT TELEPHONE NUMBER	<input type="text"/>		

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273 (02/02)