Building cells

Dr Josep Planell, Director of the Institute for Bioengineering of Catalonia, talks to William Payne about his work on tissue regeneration at the nano-scale.

Degenerative diseases such as osteoporosis, Alzheimers, Parkinsons, heart disease and cancer are amongst the main health challenges in developed countries. They bring tragedy and suffering to millions. For society, they entail a heavy cost in morbidity and lost potential, as well as consuming major healthcare resources.

Replacing and repairing diseased tissue is a major goal in combating degenerative diseases. Using grafts taken from elsewhere on the patient, from donors or animals is fraught with problems. Suitable tissue may not be available. Or it could pose a risk of rejection or infection.

For that reason, scientists have focused efforts on regenerating tissue: building bone, nerve tissue or even whole organs in a lab from the patient's own stem cells. According to Dr Josep Planell, Director of the Institute for Bioengineering of Catalonia (IBEC), "replacing damaged tissue by regeneration would change medical science definitely and radically."

Although cells have micrometre dimensions, they grow and live in a support environment - the extracellular matrix - that is nanometre sized. Engineering tissue is hugely ambitious - and researchers face many challenges. Solving these challenges requires better understanding of just how different organs and tissue grow and connect in their nano-scale environment, and how nano-scale materials can affect cell chemistry.

One big challenge Dr Planell's team at IBEC is tackling is creating scaffolds for rebuilding bones with just the right structure and size to promote strong, healthy growth and easy knitting with existing tissue. Engineers have developed many different approaches to building biodegradeable scaffolds and injecting cells into the microstructure. Many of these approaches promote fast bone growth, and appear very cost-efficient. But the most important question - which technique produces the strongest bones and best prevents future fractures - has been uncertain.

Dr Planell's team found that fastest is not always best - at least where bone growth is concerned. Techniques that produce looser, more flexible scaffolds, combined with slower, more complex cell seeding produces functional bones, the IBEC team discovered.

Building structures at the nano-scale can even change basic chemistry. A team from IBEC led by Dr Planell and a colleague, Dr Elisabeth Engel, compared tissue growth on scaffolds built from both micro and nano-scale particles. They found that differences in particle size affected chemical activity within surrounding biological media, which had an impact on tissue regrowth and density.

Understanding the ways that features such as physical

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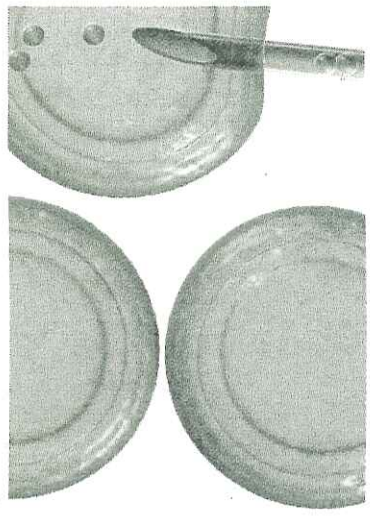

Cells live in a nano-sized support environment

topography affect cell chemistry also helps scientists create tissue substitutes that are more biocompatible and adherent to existing cells, as well as promoting stronger and healthier natural tissue regrowth.

Advances in nanotechnology are leading to medicine personalised to each individual. According to Dr Planell, that means it will be easier to detect disease, even before any symptoms show up. Nanotechnology will also make it possible to target powerful drugs precisely onto diseased areas. The result will be a healthier population, reduced morbidity and more cost-effective healthcare.

PROFILE: IBEC

The Institute for Bioengineering of Catalonia (IBEC) is a research institute covering most bioengineering fields, from basic research to medical applications. It was created in order to further the development of multidisciplinary research in biomedical engineering, offering technological expertise to hospitals, biomedical research centres and universities.

IBEC focuses its activity on six research programmes: cellular biotechnology; biomechanics and cellular biophysics; nanobiotechnology; biomaterials, implants and tissue engineering; medical signals and instrumentation; robotics and biomedical imaging.

IBEC is a non-profit private foundation established in 2005 by the Ministries of Innovation, Universities and Enterprises and Health of the Generalitat de Catalunya, the University of Barcelona and the Technical University of Catalonia.

IBEC is located in Barcelona

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