

Growing new bones in the laboratory

A researcher at the RCSI in Dublin is studying ways of growing replacement bone for patients suffering from cancer or osteoporosis, writes **Claire O'Connell**

If you sometimes feel like you are cracking up, you may not be too wide of the mark. Exercise and everyday activities can cause tiny cracks in our bones, and the body repairs them as part of a healthy bone replenishment cycle. But if that cycle goes awry, bones can become weak or fail to recover from trauma.

Now Irish researchers are zoning in on these bone "microcrack" and repair mechanisms to improve treatments for conditions such as osteoporosis, unresolved fractures and bone cancer.

"Microcracks are generally a good thing," says Dr Fergal O'Brien, a senior lecturer at the Royal College of Surgeons in Ireland (RCSI). "If you go for a jog or as we walk around day to day we are generating cracks in

our bone, and it increases the amount of bone turnover or bone repair. So your bones are constantly being changed and replenished. The problem is that if you get too many cracks, the capacity for bone repair can be exceeded."

The microcracks in question are tiny - about 0.05 of a millimetre, according to Dr O'Brien. But there's a limit to what the body can deal with. "We have shown that if cracks get much longer than one tenth of a millimetre that this tends to exceed the capacity for repair. That's when problems begin to emerge," he says.

These problems can include stress fractures for athletes who are exercising intensely, he explains. Increased microcracks could also contribute to osteoporosis in people whose bone



repair mechanisms are impaired, particularly post-menopausal women, weakening the bones and making them more likely to fracture.

Screens for osteoporosis currently focus on the amount of bone present, and common drug treatments aim to stop the body from removing damaged bone as part of its repair mechanism, explains Dr O'Brien.

Dr Fergal O'Brien with a femur, a hip-replacement joint, and a collagen scaffold on which to grow bone cells, at the RCSI.

Photograph: Dave Meehan

But while this approach can stop bone loss and improve bone mass in the short term, he has concerns about the potential long-term effects of shutting down bone repair. "Cutting off remodelling completely with drugs prevents bone loss, but our worry is that the microcracks never get repaired," he explains. "So you may have lots and lots of bone there, but cracks which should have been repaired never get repaired and this may lead to a catastrophic fracture."

So instead of just looking at bone quantity, Dr O'Brien believes we should also be examining the quality of bone present, including microcracks. Together with researchers at RCSI and Trinity College Dublin, he is developing chemical dyes and radio-opaque markers that can highlight microcracks in a bone scan. And they are looking at a cellular and molecular level to understand how the bone cracks stimulate repair, with the hope of discovering better approaches to treating osteoporosis.

The researchers are also experimenting with tissue engineering as a way to help repair larger injuries, like fractures that haven't healed properly

or bones from which cancerous growths have been removed.

The ideal would be to take stem cells from a patient, grow up tissue from them on a specialised scaffold in the lab and then implant the engineered tissue back at the damaged site, explains Dr O'Brien, who receives funding from Science Foundation Ireland, Enterprise Ireland and the Health Research Board.

"Ultimately, and we are a long way from it, the idea would be that you wouldn't need to remove bone from somebody's hip in order to put it in their long bones into a cancerous growth or non-union fracture. You could just take their cells, grow them up, produce a tissue and then implant it back in," he explains. "Really this is the future that we are talking about, but the results to date are looking very promising."

◆ *Dr Fergal O'Brien will give an informal, public talk at 7.45pm tonight entitled Grow Your Own Bones - Future Technologies in Medicine? at the Alchemist Cafe, The Mercantile, Dame Street, Dublin 2. Admission is free. See www.alchemistcatedublin.com*

