Gene therapy is first deafness 'cure'

by **Andy Coghlan**

A pioneering form of gene therapy has apparently cured deafness in guinea pigs, raising hopes that the same procedure might work in people.

"It's the first time anyone has biologically repaired the hearing of animals," says Yehoash Raphael at the University of Michigan in Ann Arbor, Michigan, and head of the US-Japanese team that developed the technique.

The therapy promotes the regrowth of crucial hair cells in the cochlea, the part of the inner ear which registers sound. After treatment, the researchers used sensory electrodes around the animals' heads to show that the auditory nerves of treated - but not untreated - animals were now registering sound.

Deafness is a major problem in people: millions of people worldwide become deaf or hearing impaired every year. This can occur if a person's inner-ear hair cells are destroyed by exposure to loud noise, to some antibiotic drugs, or simply through old age. The hair cells act like miniature microphones, capturing sound vibrations from fluid in the ear and translating the movement into nerve signals.

Raphael says one future possibility would be to use the therapy to improve hearing in people who already wear cochlear implants. These electrical devices are of some help to people lacking hair cells, but the regrowth of even some hairs could boost their hearing further. Raphael says that the next experiments in guinea pigs will focus on this combination.

Gene smuggler

Raphael's team first gave the guinea pigs antibiotics which destroyed their inner-ear hair cells. They then apparently repaired the damage by injecting them with genetically engineered adenoviruses. The viruses had been engineered to be harmless while also smuggling a gene called *Atoh1* into cells lining the scala media - the key chamber of the cochlea, containing the hair cells. *Atoh1*, also known as *Math1*, makes a signalling molecule known to orchestrate the development of hair cells in embryos.

The experiment worked beyond expectation. "The recovery of hair cells brought the treated ears to between 50% and 80% of their original hearing thresholds," says Raphael. Even more surprising, the team found that the hair cells were created from cells lining the scala media which, according to biological orthodoxy - should not be able to turn into other cells.

Stem cells to hair cells

Raphael warns that there are many obstacles to overcome before the procedure could be used in people. For example, the scala media is buried deep within human skulls, making it virtually inaccessible by surgery. And there is also a possibility that human immune systems could react against the viruses.

Another approach to regrowing the hair cells is to use embryonic stem cells, with research in this area led by Stefan Heller and colleagues at the Massachusetts Eye and Ear Infirmary in Boston, US. Heller's team produced the inner-ear hair cells by exposing embryonic cells in the lab to chemical factors which steer the natural development of hair cells. The team then implanted them into chicken embryos and the cells continued to develop just like the native hair cells already present in the chick embryo.

Raphael's work is "extremely important", says Heller, as it shows the hairs can regrow and improve hearing. "There are now at least two possibilities for the development of a cure for deafness. It is highly likely that both approaches or a combination of those will find their way into the clinic within the next decade," he told **New Scientist**.