The Neuro-Prosthesis Lab: Knowledge Centre

There are around 300 million people across the world that can be classed legally blind. Of these 150 million are completely without sight and currently there is no effective treatment for many of these persons. Two key restorative approaches which hope to bring back vision are stem cell therapies and neuroprosthesis, both of which are steadily advancing towards useful clinical therapies.

Visual cortical prosthesis is not a new concept. Forster first demonstrated phosphene response in the human visual cortex in 1929. This was followed up with the first chronic implant by Brindley and Lewin in 1968, and acute patient trials by Dobelle and Mladejovsky in 1974. However, since then, progress in brain prostheses has been extremely slow. In short, the technology has been too primitive to proceed to clinical therapy.

Then in 1992 a team in California discovered that in Retinitis Pigmentosa the communications cells in the eye stayed largely intact. Retinitis Pigmentosa is a hereditary condition that affects 1:3000 and causes degeneration of the light sensing cells in the eye. For many years it was assumed that the retina simply withered away, but the 1992 discovery opened up the possibility of retinal prosthesis. If there were cells still intact, they could be communicated with by electronic means. As it was much safer and less invasive than visual prosthesis, the field largely focussed on this form of prosthesis for the following few decades.

The efforts have led to two clinically available devices. The Argus2 from 2nd Sight, and the Retina AG implant. Both involve implanting a chip into the retina which stimulate the remaining cells. The vision returned is a blurred tunnel vision with the equivalent of a few 100 pixels of resolution. This can be compared to 2million pixels in an IPad device. They are thus only ‘useful’ to people who are fully dark blind. Patients with these are still legally blind and the level of vision returned is still worse that late stage Retinitis Pigmentosa.

In the pipeline there are more advanced implantable chips which cover a wider area of the visual field. i.e. no longer a tunnel. Other groups are working on an approach which could be used in mid stage Retinitis Pigmentosa which stimulates the periphery while allowing the patient to use their remaining natural sight for the centre. These will probably go to trials in the next 5 years with devices available clinically/commercially in 10-15 years. It should also be noted that further advancements will be made in the future, but damage to the retina is caused during the insertion, so it is not something that can be upgraded on a regular basis like a mobile phone.

Of great potential is the new field of optogenetics. This approach combines a gene therapy approach which genetically re-engineers one of the remaining layers in the eye to be light sensitive. A special pair of goggles is then worn allow the patient to see. This has the potential to bring back near-normal vision, but will some years before it is proved safe and will be brought to market. The key company involved in the commercialisation of this work is Gensight Biologics, based in Paris, who aim to start human trials in the near future.